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U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Radiation Programs

INTERNATIONAL NUMERICAL MULTIPLE AND SUBMULTIPLE PREFIXES

Multiples and submultiples	Prefixes	Symbols	Pronunciations
10^{12}	tera	T	tĕr'a
10^{9}	giga	G	jĭ'ga
10^{6}	mega	M	mĕg'a
10^{3}	kilo	k	kĭ'lo
10^{2}	hecto	h	hĕk'to
10	deka	da	dĕk'a
10^{-1}	deci	d	dĕs'i
10^{-2}	centi	c	sĕn'ti
10^{-3}	milli	m	mĭl'i
10^{-6}	micro	μ	mi'kro
10^{-9}	nano	n	năn'o
10^{-12}	pico	p	pē'ko
10^{-15}	femto	f	fĕm'to
10^{-18}	atto	a	ăt'to

SYMBOLS, UNITS, AND EQUIVALENTS

Symbol	Unit	Equivalent
Å	angstrom	10^{-10} meter
a	annum, year	
BeV	billion electron volts	GeV
Ci	curie	3.7×10^{10} dps
cm	centimeter(s)	0.394 inch
cpm	counts per minute	
dpm	disintegrations per minute	
dps	disintegrations per second	
eV	electron volt	1.6×10^{-12} ergs
g	gram(s)	
GeV	giga electron volts	1.6×10^{-3} ergs
kg	kilogram(s)	1,000 g = 2.205 lb.
km²	square kilometer(s)	
kVp	kilovolt peak	
m³	cubic meter(s)	
mA	milliampere(s)	
mCi/mi²	millicuries per square mile	0.386 nCi/m² (mCi/km²)
MeV	million (mega) electron volts	1.6×10^{-6} ergs
mg	milligram(s)	
mi²	square mile(s)	
ml	milliliter(s)	
mm	millimeter(s)	
nCi/m²	nanocuries per square meter	2.59 mCi/mi²
pCi	picocurie(s)	10^{-12} curie = 2.22 dpm
R	roentgen	
rad	unit of absorbed radiation dose	100 ergs/g

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RADIATION DATA AND REPORTS

Volume 13, Number 8, August 1972

Radiation Data and Reports, a monthly publication of the Environmental Protection Agency, presents data and reports provided by Federal, State, and foreign governmental agencies, and other cooperating organizations. Pertinent original data and interpretive manuscripts are invited from investigators.

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. This responsibility was delegated to the Bureau of Radiological Health, Public Health Service. Pursuant to the Reorganization Plan No. 3 of 1970, effective December 2, 1970, this responsibility was transferred to the Radiation Office of the Environmental Protection Agency which was established by this reorganization.

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SECTION I. MILK AND FOOD

Milk Surveillance, April 1972

Although milk is only one of the sources of dietary intake of environmental radioactivity, it is the food item that is most useful as an indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Fresh milk is consumed by a large segment of the population and contains several of the biologically important radionuclides that may be released to the environment from nuclear activities. In addition, milk is produced and consumed on a regular basis, is convenient to handle and analyze, and samples representative of general population consumption can be readily obtained. Therefore, milk sampling networks have been found to be an effective mechanism for obtaining information on current radionuclide concentrations and long-term trends. From such information, public health agencies can determine the need for further investigation or corrective public health action.

The Pasteurized Milk Network (PMN) sponsored by the Office of Radiation Programs, Environmental Protection Agency, and the Office of Food Sanitation, Food and Drug Administration, Public Health Service, consists of 63 sampling stations: 61 located in the United States, one in Puerto Rico, and one in the Canal Zone. Many of the State health departments also conduct local milk surveillance programs which provide more comprehensive coverage within the individual State. Data from 15 of these State networks are reported routinely in *Radiation Data and Reports*. Additional networks for the routine surveillance of radioactivity in milk in the Western Hemisphere and their sponsoring organizations are:

Pan American Milk Sampling Program (Pan American Health Organization and U.S. Environmental Protection Agency)—5 sampling stations

Canadian Milk Network (Radiation Protection Division, Canadian Department of National Health and Welfare)—16 sampling stations.

The sampling locations that make up the networks presently reporting in *Radiation Data and Reports* are shown in figure 1. Based on the similar purpose for these sampling activities, the present format integrates the complementary data that are routinely obtained by these several milk networks.

Radionuclide and element coverage

Considerable experience has established that relatively few of the many radionuclides that are formed as a result of nuclear fission become incorporated in milk (*1*). Most of the possible radiocontaminants are eliminated by the selective metabolism of the cow, which restricts gastrointestinal uptake and secretion into the milk. The five fission-product radionuclides which commonly occur in milk are strontium-89, strontium-90, iodine-131, cesium-137, and barium-140. A sixth radionuclide, potassium-40, occurs naturally in 0.0118 percent (*2*) abundance of the element potassium, resulting in a specific activity for potassium-40 of 830 pCi/g total potassium.

Two stable elements which are found in milk, calcium and potassium, have been used as a means for assessing the biological behavior

Figure 1. Milk sampling networks in the Western Hemisphere

of metabolically similar radionuclides (radiostrontium and radiocesium, respectively). The contents of both calcium and potassium in milk have been measured extensively and are relatively constant. Appropriate values and their variations, expressed in terms of 2 standard deviations (2σ), for these elements are 1.16 ± 0.08 g/liter for calcium and 1.51 ± 0.21 g/liter for potassium. These figures are averages of data from the PMN for May 1963–March 1966 (*3*) and are used for general radiation calculations.

Accuracy of data from various milk networks

In order to combine data from the international, national, and State networks considered in this report, it was first necessary to determine the accuracy with which each laboratory is making its determinations and the agreement of the measurements among the laboratories. The Analytical Quality Control Service of the Office of Radiation Programs conducts periodic studies to assess the accuracy of determinations of radionuclides in milk performed by interested radiochemical laboratories. The generalized procedure for making such a study has been outlined previously (*4*).

The most recent study was conducted during July 1971 with 37 laboratories participating in an experiment on a milk sample containing known concentrations of iodine-131, cesium-137, strontium-89, and strontium-90 (*5*). Of the 17 laboratories producing data for the networks reporting in *Radiation Data and Reports*, 14 participated in the study.

The accuracy results of this study for these 14 laboratories are shown in table 1. Considerable improvement has been made in the accuracy of the analyses of all radionuclides compared to the results of previous studies. Some improvement is still needed in the technique for determining the strontium-90 results. These possible differences should be kept in mind when considering the integration of data from the various networks.

Development of a common reporting basis

Since the various networks collect and analyze samples differently, a complete understanding of several parameters is useful for interpreting the data. Therefore, the various milk surveillance networks that report regularly were surveyed for information on analytical methods, sampling and analysis frequencies, and estimated analytical errors associated with the data.

In general, radiostrontium is collected by an ion-exchange technique and determined by beta-particle counting in low-background detectors, and the gamma-ray emitters (potassium-40, iodine-131, cesium-137, and barium-140) are determined by gamma-ray spectroscopy of whole milk. Each laboratory has its own modifications and refinements of these basic methodologies.

Many networks collect and analyze samples on a monthly basis. Some collect samples more frequently but composite the several samples for one analysis, while others carry out their analyses more often than once a month. Many networks are analyzing composite samples on a quarterly basis for certain nuclides. The frequency of collection and analysis varies not only among the networks but also at different

Table 1. Distribution of mean results, quality control experiment

Isotope and known concentration	Number of laboratories in each category				Experimental 2σ error (pCi/liter)
	Acceptable[a]	Warning level[b]	Unacceptable[c]	Total	
Iodine-131 (69 pCi/liter)	13 (100%)	0	0	13	6
Cesium-137 (52 pCi/liter)	12 (92%)	1 (8%)	0	13	6
Strontium-89 (31 pCi/liter)	9 (90%)	1 (10%)	0	10	6
Strontium-90 (41.6 pCi/liter)	9 (69%)	1 (8%)	3 (23%)	13	24

[a] Measured concentration equal to or within 2σ of the known concentration.
[b] Measured concentration outside 2σ and equal to or within 3σ of the known concentration.
[c] Measured concentration outside 3σ of the known concentration.

stations within some of the networks. In addition, the frequency of collection and analysis is a function of current environmental levels. The number of samples analyzed at a particular sampling station under current conditions is reflected in the data presentation. Current levels for strontium-90 and cesium-137 are relatively stable over short periods of time, and sampling frequency is not critical. For the short-lived radionuclides, particularly iodine-131, the frequency of analysis is critical and is generally increased at the first measurement or recognition of a new influx of this radionuclide.

The data in table 2 shows whether raw or pasteurized milk was collected. An analysis (*7*) of raw and pasteurized milk samples collected during January 1964 to June 1966 indicated that for relatively similar milkshed or sampling areas, the differences in concentration of radionuclides in raw and pasteurized milk are not statistically significant (*7*). Particular attention was paid to strontium-90 and cesium-137 in that analysis.

Practical reporting levels were developed by the participating networks, most often based on 2-standard-deviation counting errors or 2-standard-deviation total analytical errors from replicate analyses (*3*). The practical reporting level reflects analytical factors other than statistical radioactivity counting variations and will be used as a practical basis for reporting data.

The following practical reporting levels have been selected for use by all networks whose practical reporting levels were given as equal to or less than the given value.

Radionuclide	Practical reporting level (pCi/liter)
Strontium-89	5
Strontium-90	2
Iodine-131	10
Cesium-137	10
Barium-140	10

Some of the networks gave practical reporting levels greater than those above. In these cases, the larger value is used so that only data considered by the network as meaningful will be presented. The practical reporting levels apply to the handling of individual sample determinations. The treatment of measurements equal to or below these practical reporting levels for calculation purposes, particularly in calculating monthly averages, is discussed in the data presentation.

Analytical error or precision expressed as pCi/liter or percent in a given concentration range has also been reported by the networks (*3*). The precision errors reported for each of the radionuclides fall in the following ranges:

Radionuclide	Analytical errors of precision (2 standard deviations)
Strontium-89	1–5 pCi/liter for levels <50 pCi/liter; 5–10% for levels ≥50 pCi/liter;
Strontium-90	1–2 pCi/liter for levels <20 pCi/liter; 4–10% for levels ≥20 pCi/liter;
Iodine-131, Cesium-137, Barium-140	4–10 pCi/liter for levels <100 pCi/liter; 4–10% for levels ≥100 pCi/liter.

For iodine-131, cesium-137, and barium-140, there is one exception for these precision error ranges: 25 pCi/liter at levels <100 pCi/liter for Colorado. This is reflected in the practical reporting level for the Colorado milk network.

Federal Radiation Council guidance applicable to milk surveillance

In order to place the U.S. data on radioactivity in milk presented in *Radiation Data and Reports* in perspective, a summary of the guidance provided by the Federal Radiation Council for specific environmental conditions was presented in the December 1970 issue of *Radiological Health Data and Reports.*

Data reporting format

Table 2 presents the integrated results of the international, national, and State networks discussed earlier. Column 1 lists all the stations

Table 2. Concentrations of radionuclides in milk for April 1972 and 12-month period, May 1971 through April 1972

Sampling location		Type of sample[a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average[b]	12-month average	Monthly average[b]	12-month average
UNITED STATES:						
Ala:	Montgomery[c]	P	6	7	0	9
Alaska:	Palmer[c]	P	5	5	12	11
Ariz:	Phoenix[c]	P	0	0	0	0
Ark:	Little Rock[c]	P	12	12	0	12
Calif:	Sacramento[c]	P	3	1	0	0
	San Francisco[c]	P	0	3	0	0
	Del Norte	P	15	12	10	11
	Fresno	P	2	2	0	5
	Humboldt	P	6	4	0	7
	Los Angeles	P	0	2	0	4
	Mendocino	P	8	6	0	7
	Sacramento	P	3	2	0	5
	San Diego	P	0	1	0	4
	Santa Clara	P	2	1	0	7
	Shasta	P	4	3	0	7
	Sonoma	P	3	2	0	7
Colo:	Denver[c]	P	3	5	0	7
	East	R	(d)		<0 (2)	<0
	Northeast	R	(d)		<0 (2)	1
	Northwest	R	(d)		NS	<0
	South Central	R	(d)		NS	NS
	Southeast	R	(d)		<0	<0
	Southwest	R	(d)		<0	2
	West	R	(d)		NS	<0
Conn:	Hartford[c]	P	5	6	13	9
	Central	P	7	7	14	15
Del:	Wilmington[c]	P	8	8	12	4
D.C:	Washington[c]	P	5	7	0	7
Fla:	Tampa[c]	P	5	5	33	41
	Central	R	3	5	36	45
	North	R	3	10	19	24
	Northeast	R	8	7	30	34
	Southeast	R	5	6	28	55
	Tampa Bay area	P	3	5	32	39
	West	R	10	10	26	20
Ga:	Atlanta[c]	P	9	9	13	16
Hawaii:	Honolulu[c]	P	2	3	13	3
Idaho:	Idaho Falls[c]	P	5	5	0	1
Ill:	Chicago[c]	P	6	7	18	11
Ind:	Indianapolis[c]	P	7	7	0	4
	Central	P	10	7	10	13
	Northeast	P	10	7	20	15
	Northwest	P	9	8	20	15
	Southeast	P	9	8	10	15
	Southwest	P	10	8	15	16
Iowa:	Des Moines[c]	P	0	5	0	2
	Iowa City	P	7	6	0	10
	Des Moines	P	8	7	14	10
	Little Cedar	P	7	7	11	12
	Spencer	P	NS	6	NS	12
Kans:	Wichita[c]	P	6	8	0	2
	Coffeyville	P	7	8	0	13
	Dodge City	P	4	5	0	10
	Falls City, Nebr	R	0	5	NA	7
	Hays	P	NS	10	NS	6
	Kansas City	P	6	9	12	12
	Topeka	P	7	8	12	8
	Wichita	P	5	9	0	11
Ky:	Louisville[c]	P	8	8	12	8
La:	New Orleans[c]	P	14	14	15 (2)	15
Maine:	Portland[c]	P	5	7	27	20
Md:	Baltimore[c]	P	6	8	23	7
Mass:	Boston[c]	P	5	8	13	11
Mich:	Detroit[c]	P	8	7	14	10
	Grand Rapids[c]	P	7	8	14	10
	Bay City	P	5	6	14 (2)	15
	Charlevoix	P	NS	9	NS	15
	Detroit	P	2	6	15	11
	Grand Rapids	P	5	6	23	9
	Lansing	P	4	7	17	16
	Marquette	P	9	8	24	24
	Monroe	P	2	3	11	4
	South Haven	P	6	6	8	10
Minn:	Minneapolis[c]	P	7	8	17	16
	Bemidji	P	7	9	21	19
	Duluth	P	17	18	27	32
	Fergus Falls	P	6	8	16	18
	Little Falls	P	12	17	18	29
	Mankato	P	4	6	15	12
	Minneapolis	P	6	8	NS	17

See footnotes at end of table.

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Table 2. Concentrations of radionuclides in milk for April 1972 and 12-month period, May 1971 through April 1972 —continued

Sampling location		Type of sample[a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average[b]	12-month average	Monthly average[b]	12-month average
UNITED STATES:—continued						
Minn:	Rochester	P	6	8	12	14
	Worthington	P	NS	6	NS	12
Miss:	Jackson[c]	P	12	12	13	10
Mo:	Kansas City[c]	P	5	8	11	6
	St. Louis[c]	P	7	5	0	6
Mont:	Helena[c]	P	4	6	0	9
Nebr:	Omaha[c]	P	8	7	0	4
Nev:	Las Vegas[c]	P	0	2	0	1
N.H.:	Manchester[c]	P	7	8	13	18
N.J:	Trenton[c]	P	8	7	0	8
N. Mex:	Albuquerque[c]	P	3	3	0	0
N.Y:	Buffalo[c]	P	5	7	11	6
	New York City[c]	P	6	7	14	11
	Syracuse[c]	P	6	7	14	8
	Albany	P	6	6	•0 (3)	•0
	Buffalo	P	14	4	•0	•0
	Massena	P	NA		•0 (2)	•0
	New York City	P	5	7	14	•0
	Syracuse	P	NA		•0	•0
N.C:	Charlotte[c]	P	11	11	12	12
N. Dak:	Minot[c]	P	11	9	12	14
Ohio:	Cincinnati[c]	P	7	6	12	2
	Cleveland[c]	P	6	7	12	7
Okla:	Oklahoma City[c]	P	7	7	0	8
Oreg:	Portland[c]	P	6	5	0	5
	Baker	P	0	2	0	0
	Coos Bay	P	4	4	0	5
	Eugene	P	0	1	0	3
	Medford	P	0	1	21	6
	Portland composite	P	NA	4	0	10
	Portland local	P	NA	5	0	11
	Redmond	P	1	3	0	0
	Tillamook	P	0	4	17	15
Pa:	Philadelphia[c]	P	5	7	13	5
	Pittsburgh[c]	P	8	10	17	7
	Dauphin	P	4	6	17	11
	Erie	P	NS	8	NS	15
	Philadelphia	P	6	5	10	14
	Pittsburgh	P	7	7	25	15
R.I:	Providence[c]	P	6	8	11	12
S.C:	Charleston[c]	P	8	9	19	16
S. Dak:	Rapid City[c]	P	7	6	0	6
Tenn:	Chattanooga[c]	P	7	8	0	10
	Memphis[c]	P	6	7	0	6
	Chattanooga	P	10	10	10	13
	Clinton	R	NA	9	35	15
	Fayetteville	R	NA	10	23	7
	Kingston	R	NA	9	21	11
	Knoxville	P	NA	8	17 (2)	10
	Lawrenceburg	R	NS	8	NS	7
	Nashville	P	NA	8	16	6
	Pulaski	R	NA	8	24	6
Tex:	Austin[c]	P	0	1	0	0
	Dallas[c]	P	8	6	0	3
	Amarillo	R	NA		NA	
	Corpus Christi	R	NA		NA	
	El Paso	R	NA		NA	
	Fort Worth	R	NA		NA	
	Harlingen	R	NA		NA	
	Houston	R	NA		NA	
	Lubbock	R	NA		NA	
	Midland	R	NA		NA	
	San Antonio	R	NA		NA	
	Texarkana	R	NA		NA	
	Uvalde	R	NA		NA	
	Wichita Falls	R	NA		NA	
Utah:	Salt Lake City[c]	P	4	5	0	9
Vt:	Burlington[c]	P	4	5	15	12
Va:	Norfolk[c]	P	6	8	15	6
Wash:	Seattle[c]	P	0	4	0	6
	Spokane[c]	P	5	6	13	8
	Benten County	R	NS	1	NS	0
	Franklin County	R	3	1	0	4
	Sandpoint, Idaho	R	12	12	17	22
	Skagit County	R	8	8	0	8
W. Va:	Charleston[c]	P	8	8	14	6
Wisc:	Milwaukee[c]	P	5	6	0	5
Wyo:	Laramie[c]	P	4	3	0	2

See footnotes at end of table.

Table 2. Concentration of radionuclides in milk for April 1972 and 12-month period, May 1972 through April 1972 —continued

Sampling location	Type of sample[a]	Radionuclide concentration (pCi/liter)			
		Strontium-90		Cesium-137	
		Monthly average[b]	12-month average	Monthly average[b]	12-month average
CANADA:					
Alberta Calgary	P	NA		17	20
Edmonton	P	NA		23	24
British Columbia: Vancouver	P	NA		19	26
Manitoba: Winnipeg	P	NA		22	23
New Brunswick: Fredericton	P	NA		17	21
Newfoundland: St. John's	P	NA		19	32
Nova Scotia: Halifax	P	NA		21	23
Ontario: Ottawa	P	NA		8	13
Sault Ste. Marie	P	NA		30	32
Thunder Bay	P	NA		24	25
Toronto	P	NA		8	13
Windsor	P	NA		8	10
Quebec: Montreal	P	NA		15	17
Quebec	P	NA		27	28
Saskatchewan: Regina	P	NA		16	17
Saskatoon	P	NA		19	19
CENTRAL AND SOUTH AMERICA:					
Canal Zone: Cristobal[c]	P	0	0	12	5
Chile: Santiago	P	0	0	0	2
Colombia: Bogota	P	0	1	0	0
Ecuador: Guayaquil	P	0	0	0	0
Jamaica: Kingston	P	3	4	24	63
Puerto Rico: San Juan[c]	P	2	3	0	8
Venezuela: Caracas	P	3	0	0	0
PMN network average[f]		6	7	10	8

[a] P, pasteurized milk.
R, raw milk.

[b] When an individual sampling result was equal to or less than the practical reporting level, a value of "0" was used for averaging. Monthly averages less than the practical reporting level reflect the fact that some but not all of the individual samples making up the average contained levels greater than the practical reporting level. When more than one analysis was made in a monthly period, the number of samples in the monthly average is given in parentheses.

[c] Pasteurized Milk Network station. All other sampling locations are part of the State or National network.

[d] Radionuclide analysis not routinely performed.

[e] The practical reporting levels for these networks differ from the general ones given in the text. Sampling results for the networks were equal to or less than the following practical reporting levels:

Iodine-131: Colorado—25 pCi/liter; Michigan—14 pCi/liter; Oregon—15 pCi/liter
Cesium-137: Colorado—25 pCi/liter; New York—20 pCi/liter; Oregon—15 pCi/liter
Strontium-90: New York—3 pCi/liter

[f] This entry gives the average radionuclide concentrations for the Pasteurized Milk Network stations denoted by footnote [c].

NA, no analysis.
NS, no sample collected.

which are routinely reported to *Radiation Data and Reports*. The relationship between the PMN stations and the State stations is shown in figure 2. The first column under each of the reported radionuclides gives the monthly average for the station and the number of samples analyzed in that month in parentheses. When an individual sampling result is equal to or below the practical reporting level for the radionuclide, a value of zero is used for averaging. Monthly averages are calculated using the above convention. Averages which are equal to or less than the practical reporting levels reflect the presence of radioactivity in some of the individual samples greater than the practical reporting level.

The second column under each of the radionuclides reported gives the 12-month average for the station as calculated from the preceding 12 monthly averages, giving each monthly average equal weight. Since the daily intake of radioactivity by exposed population groups, averaged over a year, constitutes an appropriate criterion for the case where the FRC radiation protection guides apply, the 12-month average serves as a basis for comparison.

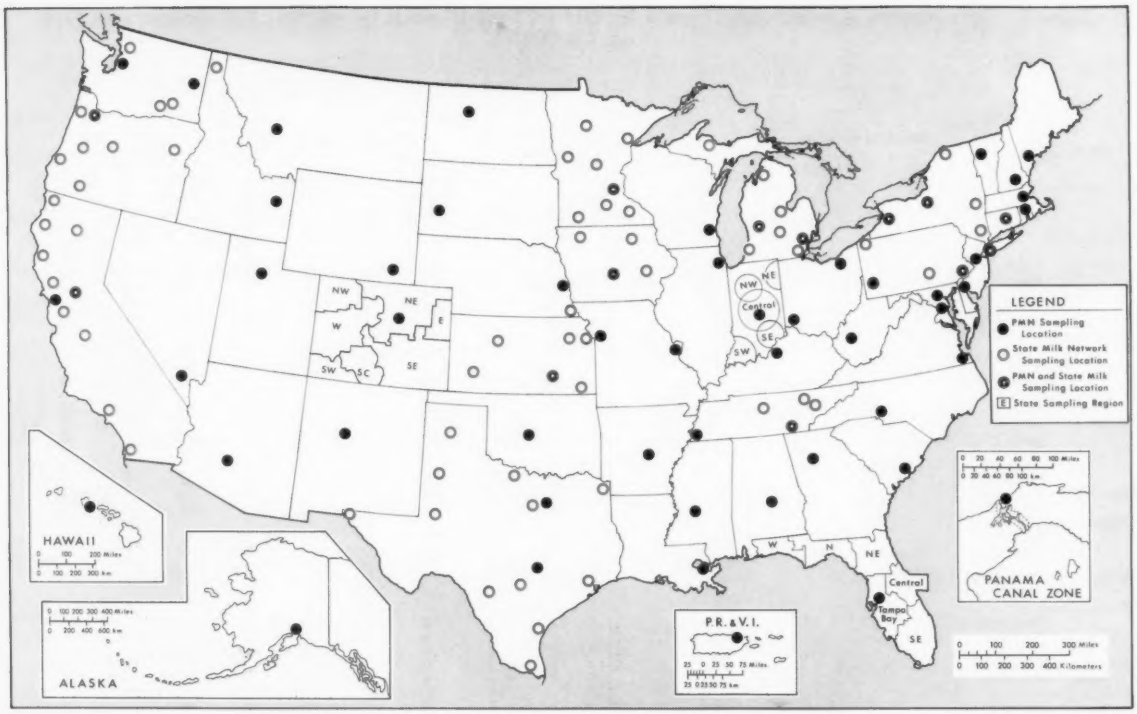

Figure 2. State and PMN milk sampling stations in the United States

Discussion of current data

In table 2, surveillance results are given for strontium-90 and cesium-137 for April 1972 and the 12-month period, May 1971 to April 1972. Except where noted, the monthly average represents a single sample for the sampling station. Strontium-89, iodine-131, and barium-140 data have been omitted from table 2 since levels at the great majority of the stations for April 1972 were below the respective practical reporting levels. Table 3 gives monthly averages for those stations at which strontium-89, iodine-131, and barium-140 were detected.

Strontium-90 monthly averages ranged from 0 to 17 pCi/liter in the United States for April 1972. The highest 12-month average was 18 pCi/liter (Duluth, Minn.) representing 9.0 percent of the Federal Radiation Council radiation

Table 3. Strontium-89, iodine-131 and barium-140 in milk, April 1972 [a]

Sampling location		Concentration (pCi/liter)		
		Strontium-89	Iodine-131	Barium-140
Calif:	Del Norte (State)	6		
	Humboldt (State)	5		
	Mendocino (State)	7		
Ga:	Atlanta (PMN)		19	
Kans:	Coffeyville (State)	6	10	
	Kansas City (State)	5	12	
	Topeka (State)		12	
	Wichita (State)	5		
Ky:	Louisville (PMN)		21	
La:	New Orleans (PMN)	12	51 (2)[b]	
Mich:	Monroe (State)			8
Miss:	Jackson (PMN)		21	
N.C:	Charlotte (PMN)		13	
S.C:	Charleston (PMN)			11
Tenn:	Chattanooga (PMN)		22	
	Chattanooga (State)		11	
	Clinton (State)		23	
	Knoxville (State)		7 (2)	
	Nashville (State)		90	
	Fayetteville (State)		71	
	Kingston (State)		38	
	Pulaski (State)		40	
C.Z:	Cristobal (PMN)		16	

[a] These levels of radioactivity are attributed to fallout from the March 18, 1972 nuclear detonation by the People's Republic of China.
[b] Number in parenthesis indicates number of samples.

protection guide. Cesium-137 monthly averages ranged from 0 to 36 pCi/liter in the United States for April 1972, and the highest 12-month average was 55 pCi/liter (Southeast Florida) representing 1.5 percent of the value derived from the recommendations given in the Federal Radiation Council report. Of particular interest are the consistently higher cesium-137 levels that have been observed in Florida (*8*) and Jamaica.

Acknowledgement

Appreciation is expressed to the personnel of the following agencies who provide data from their milk surveillance networks:

Bureau of Radiological Health
Division of Environmental Sanitation
California State Department of Health

Radiation Protection Division
Canadian Department of National Health and Welfare

Radiological Health Section
Division of Occupational and Radiological Health
Colorado Department of Health

Radiological Health Services
Division of Medical Services
Connecticut State Department of Health

Radiological and Occupational Health Section
Department of Health and Rehabilitative Services
State of Florida

Bureau of Environmental Sanitation
Division of Sanitary Engineering
Indiana State Board of Health

Division of Radiological Health
Environmental Engineering Services
Iowa State Department of Health

Radiation Control Section
Environmental Health Division
Kansas State Department of Health

Radiological Health Services
Division of Occupational Health
Michigan Department of Health

Radiation Control Section
Division of Environmental Health
State of Minnesota Department of Health

Bureau of Radiological Pollution Control
New York State Department of Environmental Conservation

Environmental Radiation Surveillance Program
Division of Sanitation and Engineering
Oregon State Board of Health

Radiological Health Section
Bureau of Environmental Health
Pennsylvania Department of Public Health

Radiological Health Services
Division of Preventable Diseases
Tennessee Department of Public Health

Division of Occupational Health
Environmental Health Services
Texas State Department of Health

Radiation Control Section
Division of Health
Washington Department of Social and Health Services

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Food and Diet Surveillance

Efforts are being made by various Federal and State agencies to estimate the dietary intake of selected radionuclides on a continuing basis. These estimates, along with the guidance developed by the Federal Radiation Council, provides a basis for evaluating the significance of radioactivity in foods and diet.

Networks presently in operation and reported routinely include those listed below. These networks provide data useful for developing estimates of nationwide dietary intakes of radionuclides. Programs reported in *Radiation Data and Reports* are as follows:

Program	Period reported	Issue
California Diet Study	July–December 1970	November 1971
Carbon-14 in Total Diet and Milk	July–December 1971	May 1972
Connecticut Standard Diet	January–December 1970	December 1971
Institutional Total Diet	October–December 1971 and 1971 Annual Summary	June 1972
Radiostrontium in Milk	January–December 1970	April 1972
Strontium-90 in Tri-City Diets	January–December 1970	November 1971

SECTION II. WATER

The Environmental Protection Agency and other Federal, State, and local agencies operate extensive water quality sampling and analysis programs for surface, ground, and treated water. Most of these programs include determinations of gross beta and gross alpha radioactivity and specific radionuclides.

Although the determination of the total radionuclide intake from all sources is of primary importance, a measure of the public health importance of radioactivity levels in water can be obtained by comparison of the observed values with the Public Health Service Drinking Water Standards (*1*). These standards, based on consideration of Federal Radiation Council (FRC) recommendations (*2-4*), set the limits for approval of a drinking water supply containing radium-226 and strontium-90 at 3 pCi/liter and 10 pCi/liter, respectively. Higher concentrations may be acceptable if the total intake of radioactivity from all sources remains within the guides recommended by FRC for control action. In the known absence[1] of strontium-90 and alpha-particle emitters, the limit is 1,000 pCi/liter gross beta radioactivity except when additional analysis indicates that concentrations of radionuclides are not likely to cause exposures greater than the limits indicated by the Radiation Protection Guides. Surveillance data from a number of Federal and State programs are published periodically to show current and long-range trends. Water sampling activities reported in *Radiation Data and Reports* are listed below.

[1] Absence is taken to mean a negligibly small fraction of the specific limits of 3 pCi/liter and 10 pCi/liter for unidentified alpha-particle emitters and strontium-90, respectively.

Water sampling program	Period reported	Issue
Colorado River Basin	1968	March 1972
Interstate Carrier Drinking Water	1971	May 1972
Kansas	January–December 1970	December 1971
Michigan	January–June 1970	November 1971
North Carolina	January–December 1967	May 1969
Radioactivity in California Waters	January–December 1970	June 1972
Radioactivity in Florida Waters	1969	January 1972
Radiostrontium in Tap Water, *HASL*	January–June 1971	April 1972
Tritium in Community Water Supplies	1969	December 1970
Tritium Surveillance System	October–December 1971	May 1972
Washington	July 1969–June 1970	March 1972
New York	July–December 1970 and January–June 1971	May 1972

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Gross Radioactivity in Surface Waters of the United States, December 1971

Office of Water Programs
U.S. Environmental Protection Agency

The monitoring of gross radioactivity in surface waters of the United States was initiated in 1957 as part of the Water Pollution Surveillance System (formerly National Water Quality Network) of the U.S. Public Health Service. Currently, the program is operated by the U.S. Environmental Protection Agency, Office of Water Programs. Regional offices of the Environmental Protection Agency are responsible for the collection of samples and the entering of the resulting data into the analytical storage and retrieval system. Radioactivity analyses are performed in the centralized radioactivity laboratories of the Office of Water Programs (Cincinnati, Ohio).

The regular reporting of gross radioactivity data in *Radiological Health Data and Reports* was terminated with the publication of data for October 1968 (April 1969 issue). With the publication of data for January 1971, this activity was resumed as a monthly report series. The unpublished data for the time interval of November 1968 through December 1970 will be the subject of a future summary article.

Table 1 presents the gross alpha and beta radioactivity results for samples collected from

Table 1. Gross radioactivity in U.S. surface waters, December 1971

River and station	Number of grab samples	Gross alpha radioactivity (pCi/liter)				Gross beta radioactivity (pCi/liter)			
		Suspended solids		Dissolved solids		Suspended solids		Dissolved solids	
Allegheny River:									
Pittsburgh, Pa	2	<0.4		<1		<1		3	(2, 3)
Animas River:									
Durango, Colo	1	<.3		<2		7		18	
Beaver River:									
New Brighton, Pa	1	2		<1		10		9	
Big Sandy River:									
Wayne County, Ky	1	<.3		1		<2		4	
Cheyenne River:									
Edgemont, S. Dak	1	1		10		6		20	
Clinch River:									
Kingston, Tenn	[a]4	<.3	(<.3, <.3)	<.5	(<.4, 0.7)	<1.2	(<1, 1.5)	8	(7,9)
Colorado River:									
Moab, Utah	[a]4	<1.5	(<.4, 4)	13	(4,24)	5	(2,10)	35	(12,69)
Above Moab, Utah	[a]4	<3	(<.4, 10)	11	(4, 22)	10	(4, 19)	32	(16,58)
DeBeque, Colo	1	<.4		8		<2		10	
Silt, Colo	1	<.3		13		2		8	
Detroit River:									
Detroit, Mich	1	<.3		<.4		<2		5	
Dolores River:									
Bedrock, Colo	[a]4	6	(2, 11)	5	(3, 8)	19	(14, 28)		(12, 22)
Gateway, Colo	[a]5	5	(1, 17)	25	(7, 57)	15	(3, 40)	60	(21, 79)
Gunnison River:									
Grand Junction, Colo	1	<.3		2		<2		14	
Guyandotte River:									
Guyandotte, W. Va	1	<.3		<.8		<2		6	
Kanawha River:									
Mason, W. Va	1	.5		<.4		<1		2	
Winfield Dam, W. Va	1	<.3		<1		<1		4	
Lake Erie:									
Buffalo, N.Y	1	.4		.7		2		6	
Maumee River:									
Toledo, Ohio	1	1		<1		3		6	
Mississippi River:									
Burlington, Iowa	1	<.3		1		<2		11	
Missouri River:									
St. Joseph, Mo	1	2		11		6		14	
St. Louis, Mo	1	2		4		6		14	
Yankton, S. Dak	1	<.4		4		<2		17	
Monongahela River:									
Pittsburgh, Pa	[a]2	<.4	(<.4, <.4)	.8	(.8, .8)	<1	(<1, <2)	5	(5, 5)
Muskingum River:									
Lock & Dam #2, Ohio	1	1		2		4		<5	
North Platte River:									
Henry, Nebr	1	1		24		4		42	

Footnote at end of table.

Table 1. Gross radioactivity in U.S. surface waters, December 1971—continued

River and station	Number of grab samples	Gross alpha radioactivity (pCi/liter)				Gross beta radioactivity (pCi/liter)			
		Suspended solids		Dissolved solids		Suspended solids		Dissolved solids	
Ohio River:									
Addison, Ohio	1	<.4		1		<2		6	
Boyd County, Ky	1	<.4		1		2		4	
Cincinnati, Ohio	[a]5	<.5	(<.3, 1)	<.6	(<.5, <.7)	<4	(<2, 11)	7	(4, 14)
Gallipolis, Ohio	1	<.4		<.7		<2		4	
Hancock, W. Va	1	1		<1		3		5	
Kyger Creek, W. Va	1	<.3		<1		<2		4	
Marietta, Ohio	1	.6		<1		3		5	
New Martinsville, W. Va	1	<.4		<1		<2		7	
Old Lock #19, W. Va	1	<.3		<1		<2		6	
South Heights, Pa	1	<.3		<1		<2		5	
Warwood, W. Va	1	.6		<1		<2		5	
Potomac River:									
Williamsport, Md	1	.6		.6		<2		<2	
Roanoke River:									
John Kerr Dam, Va	[a]2	<.3	(<.3, <.3)	<.3	(<.3, <.3)	<2	(<2, <2)	3	(3, 4)
St. Lawrence River:									
Massena, N.Y	[a]3	<.3	(<.3, <.3)	<.6	(<.5, .7)	<2	(<2, <2)	6	(5, 7)
San Miguel River:									
Naturita, Colo	[a]5	<.6	(<.3, 2)	5	(2, 7)	<2	(<2, 3)	8	(4, 16)
Uravan, Colo	[a]5	<2	(<.3, 8)	12	(3, 30)	<6	(<2, 24)	14	(6, 22)
Below Uravan, Colo	[a]5	<2	(<.3, 4)	23	(8, 33)	11	(2, 28)	42	(14, 74)
Susquehanna River:									
Conowingo, Md	1	<.3		2		<2		4	

[a] Where more than one sample is analyzed during the month, the minimum and maximum are in parentheses.

25 rivers during December 1971. The analytical procedures used for determining gross alpha and beta radioactivity are described in the 13th Edition of *Standard Methods for the Examination of Water and Wastewater* (*1*). Results are reported for the date of counting and are not corrected to the date of collection. The sensitivity in counting is that defined by the National Bureau of Standards, Handbook 86 (*2*) and is calculated to be <0.2 pCi/liter for gross alpha radioactivity and <1 pCi/liter for gross beta radioactivity measurements.

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Tritium Surveillance System, January–March 1972

Office of Radiation Programs
Environmental Protection Agency

The Tritium Surveillance System is an expansion of previous tritum surveillance activities conducted by the Office of Radiation Programs, Environmental Protection Agency (EPA). The principal effort in the past by the Office of Radiation Programs related to tritium releases has been the Tritium in Surface Water Network. This network was established in 1964 to measure and monitor tritium concentrations in major river systems in the United States and to provide surveillance at surface water stations downstream from selected nuclear facilities. The network consisted of selected stations from existing water pollution sampling stations operated by the Office of Water Programs of EPA. The final data from this network for the period January–June 1970, have been published previously (*1*).

Another effort of the Office of Radiation Programs was a tritium in precipitation program. This project was established in 1967 at selected Radiation Alert Network (RAN) stations covering the United States, including Alaska and Hawaii. The RAN is operated by the Office of Air Programs of EPA. The data from this project for July–December 1969 have been published previously (*2*). Due to the increased interest in tritium releases from nuclear facilities and the potential long-term accumulation in the environment, a national system was established to incorporate these projects or networks into one overall system.

Present network

The Tritium Surveillance System consists of 70 quarterly drinking water samples at the RAN stations, precipitation samples collected daily and analyzed monthly from 8 of the RAN stations (figure 1), and quarterly samples at

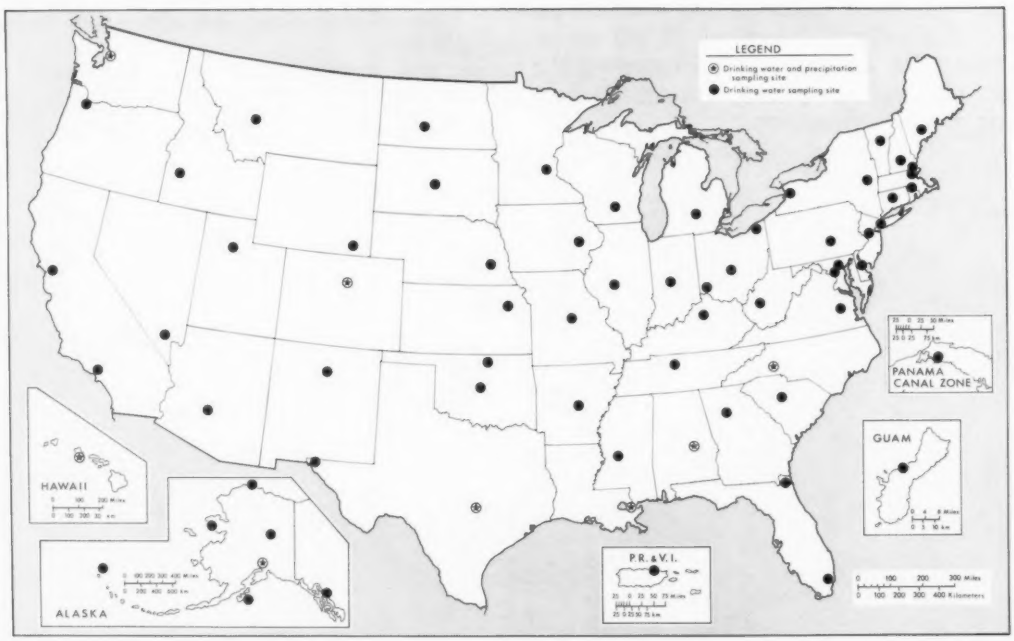

Figure 1. Drinking water and precipitation sampling locations for tritium surveillance system

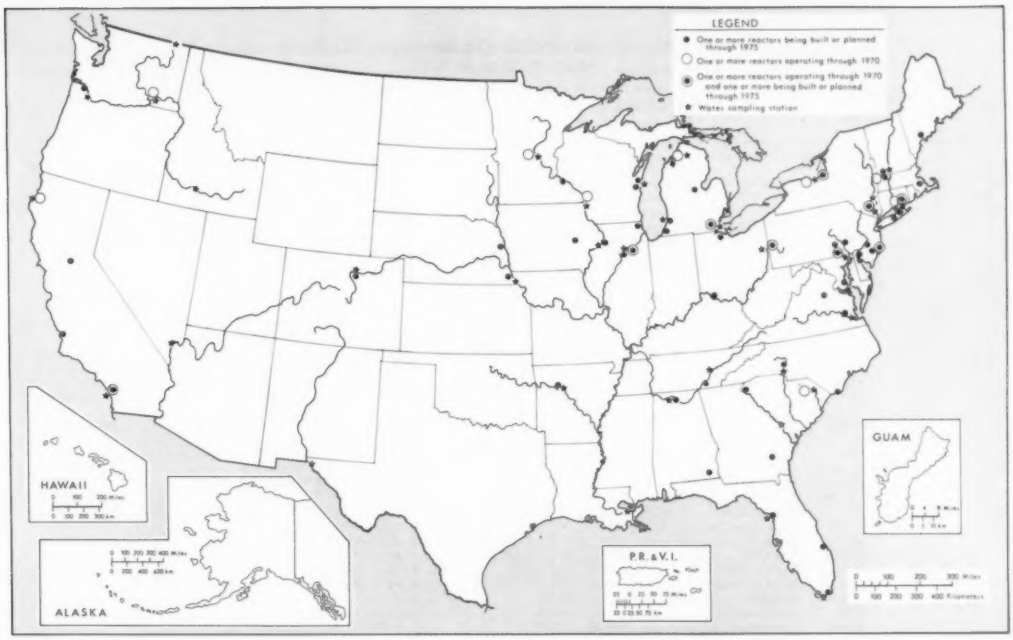
LEGEND
One or more reactors being built or planned through 1975
One or more reactors operating through 1970
One or more reactors operating through 1970 and one or more being built or planned through 1975
Water sampling station
HAWAII
ALASKA
GUAM
P.R. & V.I.

Figure 2. Surface water sampling locations for tritium surveillance system

39 surface water stations (figure 2). The specific locations for the surface water sampling system were determined by examining the water drainage areas to assure that a representative sample from a large area or region was obtained, and if possible, incorporating several nuclear facility sites. All nuclear facilities that were operating, being constructed, or planned through 1975 were considered. Consideration was also given to the current surveillance programs of the States that will be involved in the collection of the samples. The surface water samples are collected quarterly either downstream from a nuclear facility or at a background station.

The tap water samples are collected by the RAN operators on a quarterly basis. The precipitation samples are also collected by the RAN operators on a daily basis.

All samples are sent to either the Eastern Environmental Radiation Laboratory or the Western Environmental Research Laboratory for analysis. Analytical values which are not statistically significant at the 2-sigma confidence level have been reported as zero.

Results and discussion

Table 1 presents the tritium concentrations in drinking water at the RAN stations for January–March 1972. The average tritium concentration was 0.3 nCi/liter.

The radiation dose resulting from the observed tritium concentrations in the drinking water may be evaluated by using the relationship derived by Moghissi and Porter (*3*) from recommendations of the International Commission on Radiological Units and Measurements (*4*). Assuming that the concentration of tritium in all water taken into the body is equal to that found in the drinking water and also that the specific activity of tritium in the body is essentially the same as that in the drinking water, then the radiation dose may be estimated.

The highest individual concentration of tritium observed in the drinking water was 1.2 nCi/liter during the first quarter. This corresponds to a dose of 0.2 mrem/a, or less than 0.2 percent of the Federal Radiation Council's Radiation Protection Guide (170 mrem/a) for

Table 1. Tritium concentration in tap water (RAN stations) January-March 1972

Location		Date collected (1972)	Tritium concentration[a] (nCi/liter)[b]
Ala:	Montgomery	1/4	0.2
Alaska:	Anchorage	1/4	.3
	Attu Island	1/10	0
	Fairbanks	1/24	1.2
	Juneau	1/1	.9
	Kodiak	NS	
	Nome	1/7	.6
	Point Barrow	1/1	.2
Ariz:	Phoenix	1/6	0
Ark:	Little Rock	1/7	.2
Calif:	Berkeley	1/3	0
	Los Angeles	1/4	0
C.Z:	Ancon	NS	
Colo:	Denver	1/7	1.1
Conn:	Hartford	1/10	.2
Del:	Dover	1/4	0
D.C:	Washington	1/18	.3
Fla:	Jacksonville	1/3	0
	Miami	1/3	0
Ga:	Atlanta	1/4	.4
Guam:	Agana	1/3	0
Hawaii:	Honolulu	1/5	0
Idaho:	Boise	1/4	.5
Ill:	Springfield	1/3	.4
Ind:	Indianapolis	1/15	.3
Iowa:	Iowa City	1/3	.3
Kans:	Topeka	1/4	0
Ky:	Frankfort	1/11	.4
La:	New Orleans	1/10	.3
Maine:	Augusta	1/5	0
Md:	Baltimore	1/12	.4
Mass:	Lawrence	1/6	.3
	Winchester	1/10	.4
Mich:	Lansing	1/5	0
Minn:	Minneapolis	1/31	.8
Miss:	Jackson	1/4	0
Mo:	Jefferson City	1/4	0
Mont:	Helena	1/4	.6
Nebr:	Lincoln	1/3	0
Nev:	Las Vegas	1/4	1.0
N.H:	Concord	1/11	.5
N.J:	Trenton	1/5	.3
N. Mex:	Sante Fe	1/12	.3
N.Y:	Albany	1/11	.3
	Buffalo	1/5	.5
	New York	1/6	.4
N.C:	Gastonia	1/4	.3
N. Dak:	Bismark	1/11	1.0
Ohio:	Cincinnati	1/5	.3
	Columbus	1/3	.4
	Painesville	1/6	.4
Okla:	Oklahoma City	1/5	.3
	Ponca City	1/3	.3
Oreg:	Portland	1/28	0
Pa:	Harrisburg	1/17	.3
P.R:	San Juan	1/24	0
R.I:	Providence	1/13	.3
S.C:	Columbia	1/3	.3
S. Dak:	Pierre	1/3	1.2
Tenn:	Nashville	1/3	.3
Tex:	Austin	1/4	0
	El Paso	2/4	0
Utah:	Salt Lake City	1/19	.4
Vt:	Barre	1/7	0
Va:	Richmond	1/8	.3
Wash:	Seattle	1/11	.3
	Spokane	1/31	.2
W. Va:	Charleston	1/3	.3
Wisc:	Madison	1/6	.4
Wyo:	Cheyenne	NS	
Average			0.3

[a] The minimum detection limit for all samples was 0.20 nCi/liter. All values equal to or less than 0.20 nCi/liter before rounding have been reported as zero.
[b] The 2σ error for all samples is 0.2 nCi/liter unless otherwise noted.
NS, no sample.

an average dose to a suitable sample of the exposed population.

The tritium concentrations for the surface water samples are given in table 2. The highest tritium concentration was 4.7 nCi/liter for the first quarter. Assuming that the specific activity of tritium in the body is essentially the same as that in surface water, this concentra-

Table 2. Tritium concentration in surface water, January-March 1972

Location		Water source	Facility	Collection date (1972)	Concentration[a] (nCi/liter)[b]
Ala:	Decatur	Tennessee River	Browns Ferry	2/14	0.3
Ark:	Morrilton	Arkansas River	Arkansas Nuclear	1/5	.2
Calif:	Eureka	Humboldt Bay	Humboldt Bay	1/5	0
	San Onofre	Pacific Ocean	San Onofre	2/8	0
Colo:	Greely	South Platte River	Fort St. Vrain	1/10	1.3
Conn:	East Haddam	Connecticut River	Connecticut Yankee & Vermont Yankee	1/10	.4
	Waterford	Long Island Sound	Millstone	1/10	0
Fla:	Crystal River	Gulf of Mexico	Crystal River	1/20	0
	Homestead	Biscayne Bay	Turkey Point	1/11	0
Idaho:	Buhl	Snake River	National Reactor Testing Station	1/4	.4
Ill:	Moline	Mississippi River	Quad-Cities	1/19	.3
	Morris	Illinois River	Dresden and Argonne	1/13	.3
La:	New Orleans	Mississippi River	(Several)	1/4	.3
Md:	Conowingo	Susquehanna River	Peach Bottom and Three Mile Island	1/13	.4
	Lusby	Chesapeake Bay	Calvert Cliffs	1/19	0
Mass:	Rowe	Deerfield River	Yankee	1/31	.4
Mich:	Charlevoix	Lake Michigan	Big Rock Point	1/8	.3
	Monroe	Lake Erie	Enrico Fermi	1/18	.3
	South Haven	Lake Michigan	Palisades	1/8	.4
Minn:	Monticello	Mississippi River	Monticello	1/31	.9
Nebr:	Rulo	Missouri River	Fort Calhoun and Cooper	1/12	.8
Nev:	Boulder City	Colorado River	Background	1/13	1.2
N.J:	Bayside	Delaware River	Salem	1/25	0
N.Y:	Ossining	Hudson River	Indian Point	1/7	.6
	Oswego	Lake Ontario	Nine Mile Point and R. E. Ginna	1/11	.5
	Poughkeepsie	Hudson River	Background	1/12	.4
N.C:	Charlotte	Catawba River	Wm. B. McGuire	2/18	.4
Oreg:	Westport	Columbia River	Rainier and Hanford	1/1	.4
S.C:	Allendale	Savannah River	Savannah River Plant and Oconee	1/6	4.2
	Hartsville	Lake Robinson	H. B. Robinson	1/3	1.2
Tenn:	Kingston	Clinch River	Oak Ridge	1/10	4.7
Tex:	El Paso	Rio Grande	Los Alamos	2/4	.4
Vt:	Vernon	Connecticut River	Vermont Yankee	1/7	.3
Va:	Newport News	James River	Surry	[c]12/28/71	0
Wash:	Northport	Columbia River	Background	NS	
	Pasco	Columbia River	Hanford	1/7	.8
W. Va:	Wheeling	Ohio River	Shippingport	1/5	.3
Wisc:	Two Creeks	Lake Michigan	Point Beach and Kewaunee	1/24	.4
	Victory	Mississippi River	LaCrosse and Prairie Island	1/17	.5
Average					0.6

[a] The minimum detection limit for all samples was 0.20 nCi/liter. All values equal to or less than 0.20 nCi/liter before rounding have been reported as zero.
[b] The 2σ error for all samples is 0.2 nCi/liter unless otherwise noted.
[c] Sample collected early.
NS, no sample.

tion corresponds to a dose of 0.8 mrem/a, or 0.5 percent of the Radiation Protection Guide.

The monthly analyses for tritium in precipitation samples at the eight RAN stations are shown in table 3.

Table 3. Tritium concentration in precipitation from RAN stations, January-March 1972

Location		Tritium concentration[a] (nCi/liter $\pm$ 2σ)		
		January	February	March
Ala:	Montgomery	0	0.3	0
Alaska:	Anchorage	NS	.3	.3
Colo:	Denver	0	.3	.6
Hawaii:	Honolulu	0	0	0
La:	New Orleans	NS	0	.4
N.C:	Gastonia	0	0	.4
Tex:	Austin	0	NS	NS
Wash:	Seattle	0	0	0

[a] The minimum detection limit for these samples was 0.20 nCi/liter. All values equal to or less than 0.20 nCi/liter before rounding have been reported as zero. The 2σ error for all samples is 0.2 nCi/liter unless otherwise noted.
NS, No sample.

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(*1*) BUREAU OF RADIOLOGICAL HEALTH. Tritium in surface water network, January–June 1970. Radiol Health Data Rep 11:638–639 (November 1970).

(*2*) BUREAU OF RADIOLOGICAL HEALTH. Tritium in precipitation (RAN), July–December 1969. Radiol Health Data Rep 11:354–355 (July 1970).

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Other coverage in *Radiation Data and Reports:*

Period	Issue
January–March 1971	July 1971
April–June 1971	November 1971
July–September 1971	April 1972
October–December 1971	May 1972

SECTION III. AIR AND DEPOSITION

Radioactivity in Airborne Particulates and Precipitation

Continuous surveillance of radioactivity in air and precipitation provides one of the earliest indications of changes in environmental fission product radioactivity. To date, this surveillance has been confined chiefly to gross beta radioanalysis. Although such data are insufficient to assess total human radiation exposure from fallout, they can be used to determine when to modify monitoring in other phases of the environment.

Surveillance data from a number of programs are published monthly and summarized periodically to show current and long-range trends of atmospheric radioactivity in the Western Hemisphere. These include data from activities of the Environmental Protection Agency, the Canadian Department of National Health and Welfare, the Mexican Commission of Nuclear Energy, and the Pan American Health Organization.

In addition to those programs presented in this issue, the following programs were previously covered in *Radiation Data and Reports*.

Network	Period	Issue
Fallout in the United States and other areas, *HASL*	January–December 1970	December 1971
Mexican Air Monitoring Program	February–December 1971	May 1972
Plutonium in Airborne Particulates	October–December 1971	July 1972
Surface Air Sampling Program; 80th Meridian Network, *HASL*	January–December 1969	February 1972

1. Radiation Alert Network, April 1972

Division of Atmospheric Surveillance
Environmental Protection Agency

Surveillance of atmospheric radioactivity in the United States is conducted by the Radiation Alert Network (RAN) which regularly gathers samples at 70 locations distributed throughout the country (figure 1). Most of the stations are operated by State health department personnel.

The station operators perform "field estimates" on the airborne particulate samples at 5 hours after collection, when most of the radon daughter products have decayed, and at 29 hours after collection, when most of the thoron daughter products have decayed. They also perform field estimates on dried precipitation samples and report all results to appropriate Environmental Protection Agency officials by mail or telephone depending on levels found. A compilation of the daily field estimates is available upon request from the Air Quality Information Systems Branch, Division of Atmospheric Surveillance, EPA, Research Triangle Park, N.C. 27711. A detailed description of the sampling and analytical procedures was presented in the March 1968 issue of *Radiological Health Data and Reports.*

Table 1 presents the monthly average gross beta radioactivity in surface air particulates and deposition by precipitation, as measured by the field estimate technique, during April 1972.

Two stations reported high readings in precipitation for April: Nashville, Tenn.—65 nCi/m² on April 10; and Oklahoma City, Okla.—24 nCi/m² on April 27 and 21 nCi/m² on April 28, 1972.

All other field estimates reported were within normal limits for the reporting station.

Figure 1. Radiation Alert Network sampling stations

Table 1. Gross beta radioactivity in surface air and precipitation, April 1972

Station location		Number of samples	Gross beta radioactivity (5-hour field estimate) (pCi/m³)			Number of samples	Total depth (mm)	Precipitation		
								Field estimation of deposition		
			Maximum	Minimum	Average[a]			Number of samples	Depth (mm)	Total deposition (nCi/m²)
Ala:	Montgomery	18	3	1	1	2	33	2	33	3
Alaska:	Anchorage	3	0	0	0	0				
	Attu Island	0				0				
	Fairbanks	0				0				
	Juneau	17	1	0	0	6	60	6	60	17
	Kodiak	0				0				
	Nome	0				0				
	Point Barrow	0				0				
Ariz:	Phoenix	20	9	1	4	0				
Ark:	Little Rock	20	4	0	1	0				
Calif:	Berkeley	20	0	0	0	5	34	5	34	1
	Los Angeles	20	3	0	1	0				
C.Z:	Ancon	16	0	0	0	0				
Colo:	Denver	20	5	1	2	6	61	(b)		
Conn:	Hartford	19	1	0	0	9	83	9	83	1
Del:	Dover	20	1	0	0	0				
D.C:	Washington	23	2	0	0	0				
Fla:	Jacksonville	19	2	0	1	2	19	2	19	5
	Miami	20	1	0	0	2	56	2	56	0
Ga:	Atlanta	10	2	1	1	0				
Guam:	Agana	0				0				
Hawaii:	Honolulu	20	1	0	1	3	75	(b)		
Idaho:	Boise	0				0				
Ill:	Springfield	7	4	1	1	0				
Ind:	Indianapolis	20	1	0	0	0				
Iowa:	Iowa City	19	4	0	1	3	120	3	120	0
Kans:	Topeka	20	6	1	2	8	64	8	64	8
Ky:	Frankfort	0				0				
La:	New Orleans	16	0	0	0	3	23	(b)		
Maine:	Augusta	8	1	0	0	4	51	4	51	0
Md:	Baltimore	20	2	0	0	5	45	5	45	0
Mass:	Lawrence	18	1	0	0	7	79	7	79	0
	Winchester	19	2	0	1	9	92	9	92	0
Mich:	Lansing	20	1	0	0	7	98	7	98	9
Minn:	Minneapolis	19	1	0	0	3	29	3	29	7
Miss:	Jackson	15	1	0	1	2	25	2	25	13
Mo:	Jefferson City	19	3	1	1	9	100	9	100	2
Mont:	Helena	20	3	0	1	2	7	2	7	0
Nebr:	Lincoln	17	8	1	3	1	2	1	2	0
Nev:	Las Vegas	20	3	0	1	0				
N.H:	Concord	0				0				
N.J:	Trenton	20	2	0	0	9	81	9	81	13
N. Mex:	Santa Fe	19	3	0	1	0				
N.Y:	Albany	12	0	0	0	0				
	Buffalo	18	3	0	0	0				
	New York City	0				0				
N.C:	Gastonia	18	10	1	2	2	19	(b)		
N. Dak:	Bismarck	19	3	0	1	4	49	4	49	3
Ohio:	Cincinnati	0				0				
	Columbus	4	1	0	1	0				
	Painesville	19	1	0	0	8	100	8	100	31
Okla:	Oklahoma City	5	3	1	1	3	65	3	65	54
	Ponca City	19	5	1	2	5	41	5	41	0
Oreg:	Portland	19	1	0	0	13	99	13	99	11
Pa:	Harrisburg	12	1	0	0	2	24	2	24	4
P.R:	San Juan	0				0				
R.I:	Providence	20	1	0	0	0				
S.C:	Columbia	15	4	0	1	2	43	2	43	0
S. Dak:	Pierre	19	3	0	2	0				
Tenn:	Nashville	19	2	0	1	6	71	6	71	74
Tex:	Austin	15	8	2	3	1	14	(b)		
	El Paso	7	3	1	1	0				
Utah:	Salt Lake City	30	2	0	1	9	64	9	64	29
Vt:	Barre	20	2	0	1	8	58	8	58	7
Va:	Richmond	18	1	0	0	1	2	1	2	0
Wash:	Seattle	8	0	0	0	7	90	(b)		
	Spokane	20	2	0	1	0				
W. Va:	Charleston	19	2	0	1	11	117	11	117	15
Wisc:	Madison	19	1	0	0	4	66	4	66	5
Wyo:	Cheyenne	20	6	1	2	1	2	1	2	3
Network summary		995	10	0	1	194	65	5	57	10

[a] The monthly average is calculated by weighting the field estimates of individual air samples with length of sampling period.
[b] This station is part of the tritium surveillance system. No gross beta measurements are done.

2. Canadian Air and Precipitation Monitoring Program,[1] April 1972

Radiation Protection Division
Department of National Health and Welfare

The Radiation Protection Division of the Canadian Department of National Health and Welfare monitors surface air and precipitation in connection with its Radioactive Fallout Study Program. Twenty-four collection stations are located at airports (figure 2), where the sampling equipment is operated by personnel from the Meteorological Services Branch of the Department of Transport. Detailed discussions of the sampling procedures, methods of analysis, and interpretation of results of the radioactive fallout program are contained in reports of the Department of National Health and Welfare (*1–5*).

A summary of the sampling procedures and methods of analysis was presented in the May 1969 issue of *Radiological Health Data and Reports.*

Surface air and precipitation data for April 1972 are presented in table 2.

[1] Prepared from information and data obtained from the Canadian Department of National Health and Welfare, Ottawa, Canada.

Table 2. Canadian gross beta radioactivity in surface air and precipitation, April 1972

Station	Number of samples	Air surveillance gross beta radioactivity (pCi/m³)			Precipitation measurements	
		Maximum	Minimum	Average	Average concentration (pCi/liter)	Total deposition (nCi/m²)
Calgary	10	0.5	0.1	0.1	39	0.6
Coral Harbour	9	.1	.0	.1	58	1.1
Edmonton	9	.3	.1	.1	20	.8
Ft. Churchill	9	.1	.0	.1	45	.7
Fredericton	9	.2	.1	.1	286	13.0
Goose Bay	9	.1	.1	.1	51	2.8
Halifax	9	.3	.1	.2	80	9.5
Inuvik	4	.1	.0	.1	29	.8
Montreal	9	.1	.0	.0	44	2.6
Moosonee	9	.1	.0	.1	117	.9
Ottawa	9	.1	.0	.1	125	5.7
Quebec	9	.2	.0	.1	123	5.1
Regina	9	.2	.0	.1	101	2.5
Resolute	9	.1	.1	.1	NS	
St. John's, Nfld	8	.1	.1	.1	13	1.4
Saskatoon	9	.1	.1	.1	125	1.0
Sault Ste. Marie	9	.1	.0	.1	221	17.5
Thunder Bay	10	.1	.0	.1	101	2.8
Toronto	8	.1	.0	.0	107	6.3
Vancouver	9	.2	.0	.1	28	3.3
Whitehorse	9	.1	.0	.0	24	.4
Windsor	9	.3	.0	.1	35	3.8
Winnipeg	8	.1	.1	.1	550	7.1
Yellowknife	11	.2	.0	.1	264	4.0
Network summary	212	0.5	0.0	0.1	112	4.1

NS, no sample.

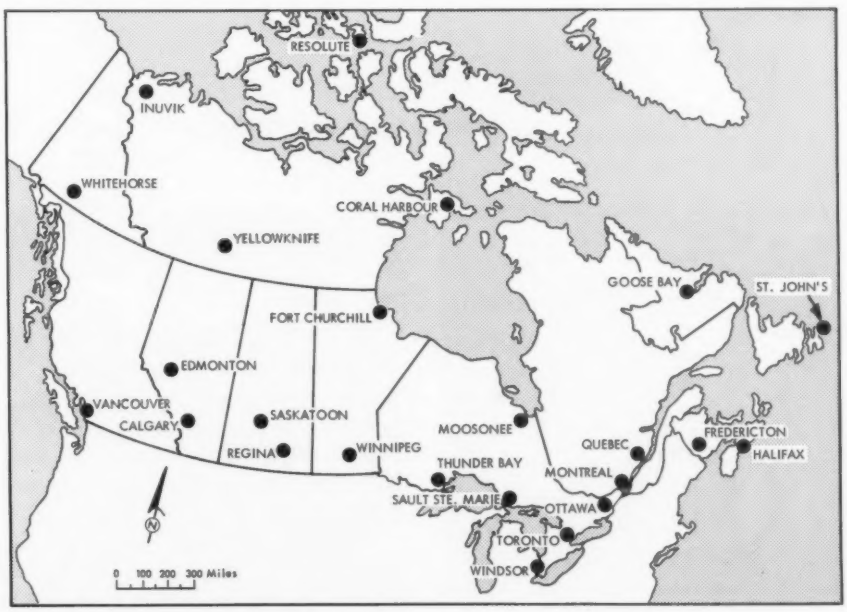

Figure 2. Canadian air and precipitation sampling stations

3. Pan American Air Sampling Program April 1972

Pan American Health Organization and U.S. Environmental Protection Agency

Gross beta radioactivity in air is monitored by countries in the Americas under the auspices of the collaborative program developed by the Pan American Health Organization (PAHO) and the Environmental Protection Agency (EPA) to assist PAHO-member countries in developing radiological health programs.

The air sampling station locations are shown in figure 3. Analytical techniques were described in the March 1968 issue of *Radiological Health Data and Reports*. The April 1972 air monitoring results from the participating countries are given in table 3.

Table 3. Summary of gross beta radioactivity in Pan American surface air, April 1972

Station location		Number of samples	Gross beta radioactivity (pCi/m³)		
			Maximum	Minimum	Average[a]
Argentina:	Buenos Aires	0			
Bolivia:	La Paz	5	0.03	0.01	0.02
Chile:	Santiago	28	.20	.04	.09
Colombia:	Bogota	20	.05	.00	.01
Ecuador:	Cuenca	1	.01	.01	.01
	Guayaquil	6	.06	.02	.04
	Quito	9	.01	.00	.00
Guyana:	Georgetown	0			
Jamaica:	Kingston	0			
Peru:	Lima	0			
Venezuela:	Caracas	16	.18	.00	.05
West Indies:	Trinidad	16	.57	.03	.15
Pan American summary		101	0.57	0.00	0.06

[a] The monthly average is calculated by weighting the individual samples with length of sampling period. Values less than 0.005 pCi/m³ are reported and used in averaging as 0.00 pCi/m³.

Figure 3. Pan American Air Sampling Program stations

4. California Air Sampling Program April 1972

Bureau of Radiological Health
California State Department of Public Health

The Bureau of Radiological Health of the California State Department of Public Health with the assistance of several cooperating agencies and organizations operates a surveillance system for determining radioactivity in airborne particulates. The air sampling locations are shown in figure 4.

All air samples are sent to the Sanitation and Radiation Laboratory of the State Department of Public Health where they are analyzed for their radioactive content.

Figure 4. California Air Sampling Program stations

Airborne particles are collected by a continuous sampling of air filtered through a 47 millimeter membrane filter, 0.8 micron pore size, using a Gast air pump of about 2 cubic feet per minute capacity, or 81.5 cubic meters per day. Air volumes are measured with a direct-reading gas meter. Filters are replaced every 24 hours except on holidays and weekends. The filters are analyzed for gross alpha and beta radioactivity. Analyses are normally made 72 hours after the end of the collection period. The daily samples are then composited into a monthly sample. A monthly gamma-scan and analysis for strontium-89 and strontium-90 are presented quarterly. Table 4 presents the monthly gross beta radioactivity in air for April 1972.

Table 4. Gross beta radioactivity in California air April 1972

Station location	Number of samples	Gross beta radioactivity (pCi/m³)		
		Maximum	Minimum	Average
Bakersfield	28	2.27	0.08	0.59
Barstow	29	4.04	.09	.62
Berkeley	29	1.90	.00	.19
Colfax	30	7.74	.05	.59
El Centro	26	2.85	.13	.68
Eureka	28	.91	.00	.19
Fresno	30	1.54	.13	.37
Los Angeles	28	.56	.00	.18
Redding	25	10.80	.08	.64
Sacramento	25	.47	.00	.19
Salinas	28	2.66	.03	.42
San Bernardino	28	1.20	.09	.44
San Diego	30	1.13	.07	.31
Santa Rosa	30	1.67	.02	.24
Summary	394	10.80	0.00	0.40

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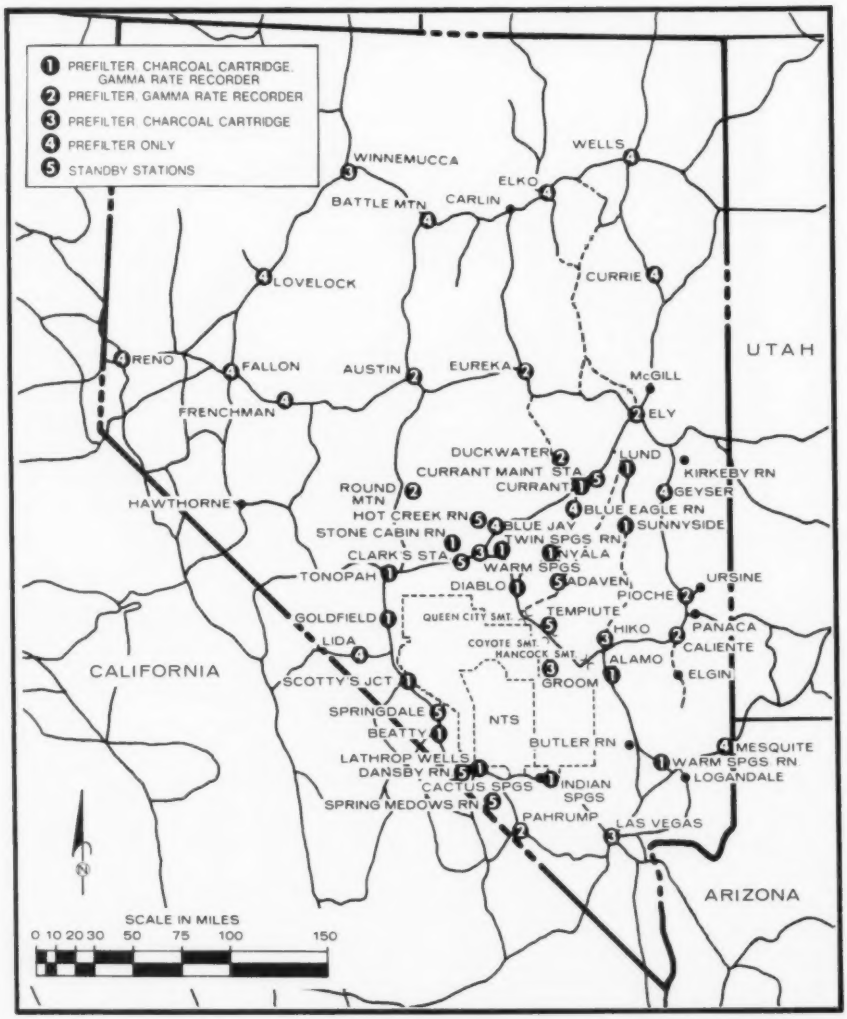

Figure 1. WERL Air Surveillance Network stations in Nevada

Air Surveillance Network, April 1972

Western Environmental Research Laboratory
Environmental Protection Agency

The Air Surveillance Network (ASN), operated by the Western Environmental Research Laboratory (WERL), consists of 104 active and 18 standby sampling stations located in 21 western States (figures 1 and 2). The network is operated in support of nuclear testing sponsored by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), by the Space Nuclear Systems Office at the Nuclear Rocket Development Station which lies within the NTS, and by the AEC at any other designated testing sites.[1]

The stations are operated by State health department personnel and by private individuals on a contract basis. Daily 24-hour samples are collected at each station. All samples are mailed to the WERL unless special retrieval is arranged at selected locations in support of known releases of radioactivity from the NTS. A complete description of sampling and analytical procedures was presented in the February 1972 issue of *Radiation Data and Reports.*

[1] The ASN is operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, U.S. Atomic Energy Commission.

Results

Table 1 presents the monthly average gross beta radioactivity in air particulates for each of the network stations. The minimum reported concentration for gross beta is 0.1 pCi/m^3; however, gross beta concentrations above the minimum detectable concentration of 0.06 pCi/m^3 are used in determining averages. Individual concentrations which are below the minimum detectable concentration are assumed to be equal to the minimum detectable concentration. Averages less than the minimum reported level are reported as <0.1 pCi/m^3. The highest gross

Figure 2. WERL Air Surveillance Network stations outside Nevada

Table 1. Summary of gross beta radioactivity concentrations in air, April 1972

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average[a]
Ariz:	Kingman	30	4.9	0.1	1.0
	Phoenix	30	2.4	.1	.9
	Seligman	30	3.5	<.1	.7
	Winslow	30	5.9	<.1	1.0
Ark:	Little Rock	19	1.8	.1	.3
Calif:	Baker	30	1.5	.1	.4
	Barstow	30	4.1	<.1	.8
	Bishop	30	3.7	.1	.7
	Death Valley Junction	30	2.8	<.1	.7
	Furnace Creek	30	2.4	<.1	.8
	Indio	30	3.8	<.1	.6
	Lone Pine	26	1.8	.1	.6
	Needles	24	2.8	.1	.8
	Ridgecrest	30	2.0	.1	.5
	Shoshone	30	1.7	<.1	.6
Colo:	Denver	20	6.5	<.1	.8
	Durango	29	3.8	.1	.7
Idaho:	Boise	30	3.7	<.1	.5
	Idaho Falls	20	1.7	<.1	.5
	Preston	29	6.0	.1	.6
	Twin Falls	30	4.0	<.1	.6
Iowa:	Iowa City	20	.4	.1	.1
	Sioux City	24	.3	<.1	.2
Kans:	Dodge City	30	.9	<.1	.2
La:	Lake Charles	19	.7	<.1	.3
	Monroe	22	1.8	<.1	.3
	New Orleans	16	2.2	.1	.4
Minn:	Minneapolis	19	.6	<.1	.2
Mo:	Joplin	30	1.9	<.1	.3
	St. Joseph	30	2.4	<.1	.3
	St. Louis	29	2.7	.1	.3
Nebr:	North Platte	24	1.7	<.1	.3
Nev:	Alamo	28	3.0	<.1	.7
	Austin	25	2.3	.1	.7
	Battle Mountain	30	2.2	<.1	.5
	Beatty	30	1.7	<.1	.5
	Blue Eagle Ranch (Currant)	27	1.1	<.1	.5
	Blue Jay	30	3.5	<.1	.6
	Caliente	29	4.4	<.1	.9
	Currant Ranch	30	1.7	.1	.6
	Currie	30	1.4	<.1	.5
	Diablo	30	2.3	<.1	.6
	Duckwater	23	3.5	<.1	.7
	Elko	29	5.0	<.1	.7
	Ely	29	1.4	<.1	.4
	Eureka	30	5.1	<.1	.9
	Fallini's Twin Springs Ranch	30	1.2	<.1	.5
	Fallon	30	4.8	.1	.6
	Frenchman Station	30	2.6	<.1	.5
	Geyser Maintenance Station	28	3.6	<.1	.7
	Goldfield	17	1.2	<.1	.5
	Groom Lake	28	2.4	.1	.8
	Hiko	30	3.7	<.1	.7
	Indian Springs	30	4.9	<.1	.7
	Las Vegas	20	3.7	.1	.9
	Lathrop Wells	27	4.0	<.1	.8
	Lida	30	2.1	<.1	.5
	Lovelock	30	3.3	<.1	.7
	Lund	30	5.8	<.1	.8
	Mesquite	30	2.1	<.1	.6
	Nyala	20	1.2	<.1	.5
	Pahrump	20	1.7	<.1	.5
	Pioche	30	4.9	<.1	.9
	Reno	30	2.4	<.1	.4
	Round Mountain	30	2.9	<.1	.7
	Scotty's Junction	27	1.4	<.1	.6
	Stone Cabin Ranch	30	1.7	<.1	.5
	Sunnyside	24	1.9	.1	.7
	Tonopah	30	1.1	<.1	.5
	Tonopah Test Range	25	1.7	<.1	.5
	Warm Springs Ranch	30	1.8	<.1	.6
	Wells	30	2.1	<.1	.6
	Winnemucca	30	1.8	<.1	.4
N. Mex:	Albuquerque	19	4.3	<.1	1.2
	Carlsbad	27	7.7	.1	1.1
Okla:	Muskogee	30	1.0	<.1	.2
Oreg:	Burns	30	3.2	<.1	.4
	Medford	25	.6	<.1	.2
S. Dak:	Aberdeen	18	.7	<.1	.2
	Rapid City	28	.8	<.1	.2
Tex:	Abilene	26	1.3	<.1	.3
	Amarillo	30	2.5	<.1	.5
	Austin	15	.9	<.1	.3
	Fort Worth	30	1.5	<.1	.5

See footnote at end of table.

Table 1. Summary of gross beta radioactivity concentrations in air, April 1972—continued

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average[a]
Utah:	Bryce Canyon	22	3.2	<.1	.7
	Cedar City	29	2.4	<.1	.7
	Delta	30	4.2	<.1	.8
	Dugway	28	1.6	<.1	.5
	Enterprise	30	2.3	<.1	.6
	Garrison	30	.6	<.1	.3
	Logan	30	3.3	<.1	.6
	Milford	30	3.8	<.1	.7
	Monticello	30	2.6	<.1	.7
	Parowan	30	7.4	<.1	.9
	Provo	29	2.7	<.1	.6
	Roosevelt	30	2.9	<.1	.7
	Salt Lake City	30	3.4	<.1	.5
	St. George	30	3.4	<.1	.6
	Wendover	31	3.7	<.1	.6
Wash:	Seattle	20	1.7	<.1	.2
	Spokane	20	1.4	.1	.2
Wyo:	Rock Springs	30	3.0	<.1	.6
	Worland	29	1.3	<.1	.4

[a] Individual values less thn the minimum detectable concentration (MDC) are set equal to the MDC for averaging. A monthly average less than the minimum reportable value of 0.1 pCi/m³ is reported as <0.1.

beta concentration within the network on a single filter during April was 7.7 pCi/m³ at Carlsbad, N. Mex.

From gamma spectrometry results, neptunium-239, uranium-237, cerium-141, barium-140, iodine-131, ruthenium-103, and zirconium-95 in varying combinations were identified on filters collected in Arizona, Arkansas, California, Colorado, Idaho, Louisiana, Missouri, Montana, Nebraska, Nevada, New Mexico, Oregon, Texas, Utah, and Wyoming. Table 2 lists the highest concentrations of these radionuclides, which are attributed to a nuclear detonation by the People's Republic of China on March 18, 1972.

Copies of this summary and listings of the daily gross beta and gamma spectrometry results are distributed to EPA regional offices and appropriate State agencies. Additional copies of the daily results may be obtained from the WERL upon written request.

Table 2. Maximum radionuclide concentrations, ASN April 1972

Location		Radionuclide	Concentration (pCi/m³)
N. Mex:	Carlsbad	Neptunium-239	14.0
Nev:	Indian Springs	Uranium-237	1.1
	Elko	Cerium-141	.9
		Barium-140	.5
Ariz:	Kingman	Iodine-131	.3
Idaho:	Boise	Ruthenium-103	.3
	Twin Falls	Ruthenium-103	.3
Utah:	Parowan	Ruthenium-103	.3
Nev:	Fallon	Zirconium-95	3.2

SECTION IV. OTHER DATA

This section presents results from routine sampling of biological materials and other media not reported in the previous sections. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities.

Offsite Surveillance Around the Nevada Test Site, July–December 1968[1]

Western Environmental Research Laboratory, EPA,[2] and Nevada Operations Office, AEC

Under a Memorandum of Understanding with the U.S. Atomic Energy Commission (AEC) the Southwestern Radiological Health Laboratory (SWRHL) conducted its continuing program of radiological surveillance, including monitoring and environmental sampling, in the public areas surrounding the Nevada Test Site (NTS) from July through December 1968. During this period, radioactivity was released from two nuclear rocket reactor tests at the Nuclear Rocket Development Station on NTS: Experimental Plan V (EP V) of the Phoebus 2A reactor test series conducted on July 18, and Experimental Plan III (EP III) of the Pewee I reactor test series on December 4. In addition, a Plowshare cratering experiment, Project Schooner, conducted at NTS on December 3, released radioactivity to the atmosphere that was detected in offsite populated locations.

Operational procedures

Comprehensive ground monitoring capabilities were maintained throughout this period. Mobile ground monitoring teams were positioned in the offsite areas prior to each event. Each monitor was equipped with an Eberline E-500B survey meter, a Baird-Atomic Model NE-148A Scintillator, and a Victoreen Radector, Model No. AGB-50B-Sr. Eberline RM-11 gamma-rate recorders at fixed locations documented cloud passage. An Air Force U-3A aircraft was used to track radioactive effluents and two SWRHL Turbo-Beech aircraft were used for sampling in the radioactive cloud to assess total cloud volume and to provide long-range tracking.

The Air Surveillance Network (ASN) operated about 110 stations in most of the States west of the Mississippi River. Additional samplers were located at strategic points to complement surveillance coverage for events from which releases of radioactivity were anticipated, i.e., Schooner, Phoebus 2A and Pewee I. The air samplers used were positive displacement vacuum pumps with an average flowrate of 10-cubic feet per minute. The filter media used were a 4-inch diameter glass fiber filter and an MSA charcoal cartridge.

In addition, 177 samples were collected from about 30 locations in the established milk sampling network. Samples were taken from both commercial dairies and private producers. Vegetation samples, including samples of milk-cow feed, were collected after known releases of radioactivity to help delineate the fallout pattern. Four hundred and five samples of both potable and nonpotable water were collected from 98 locations; nine stations in the Las

[1] This article is a summary of report No. SWRHL-83r, "Off-site Surveillance Activities of the Southwestern Radiological Health Laboratory from July through December 1968."

[2] Formerly the Southwestern Radiological Health Laboratory, of the U.S. Department of Health, Education, and Welfare, Public Health Service, Bureau of Radiological Health.

Vegas Valley were added to the network primarily for tritium investigation.

Approximately 120 residents in the offsite areas wore film badges, and five film badges were placed at each of 133 dosimetry stations. One hundred and one of these stations were also equipped with three EG&G model TL-12 thermoluminescent dosimeters (TLD's). The film badge used contained DuPont type 545 film and has a 30 mR lower limit of detection.

A SWRHL medical officer was available to investigate reports of injuries alleged to be the result of the test series and to maintain liaison with local physicians. No injuries were reported. Veterinarian services were also provided by the SWRHL to conduct wildlife and domestic livestock investigations. Other community relations services included information centers which were established in towns around the NTS during the Benham Event (conducted December 19, 1968) to notify residents of possible ground motion hazards, to evacuate specified buildings and to process any complaints following the event.

Analytical procedures

All samples were analyzed at the SWRHL in Las Vegas. Air sample particulate filters were counted for beta radioactivity in a Beckman Widebeta low background, proportional counter system. Selected particulate filters, all charcoal cartridges, and water and milk samples were analyzed for gamma-emitting isotopes using a 4- by 4-inch NaI(T1) crystal coupled to a TMC gamma-pulse height analyzer. The lower limit of detection for gamma emitters in milk samples was 20 pCi/liter at the time of count. Gamma spectra were evaluated using a matrix technique which allowed for the determination of eight nuclides simultaneously.

Results

During this period, radioactivity was released from two nuclear rocket reactor tests at the Nuclear Rocket Development Station on NTS: EP V of Phoebus 2A reactor test series conducted on July 18, and EP III of the Pewee I reactor test series on December 4, 1968. In addition, a Plowshare cratering experiment, Project Schooner, conducted at NTS on December 8th, released radioactivity to the atmosphere and was detected in offsite populated locations.

Phoebus 2A EP V

Radioactive material released by this test was detected as far as Wendover, Utah. Night drainage winds carried small amounts of gaseous material to the south over Lathrop Wells, Nev.

The only gamma exposure rate instrument readings above background were obtained at Queen City Summit, an unpopulated Nevada location. The maximum reading was 0.1 mR/h. As shown in the following tables (*1–2*), radioiodines were found in milk and air samples (figures 1 and 2). No fresh fission products were found through dosimetry or in water sampling media.

Table 1. Maximum concentrations of iodine-131 in milk at four locations following Phoebus 2A EP V

Location azimuth—distance[a]	Date (1968)	Iodine-131 (pCi/liter)
Duckwater, Nev. (Halstead Ranch) 13°, 147 miles	7/20	90
Currant, Nev. (Blue Eagle Ranch) 18°, 122 miles	7/20	60
Cherry Creek, Nev. (Paris Ranch) 17°, 238 miles	7/24	30
Nyala, Nev. (Sharp Ranch) 16°, 102 miles	7/20	30

[a] From Test Cell C.

PeWee 1 EP III

Radioactive material released by this test was detected offsite by air samplers only. As indicated in figure 3, reactor effluent ranged widely, through in negligible amounts. Emissions from reactor pulse cooldown operations and possible portions of the main reactor cloud transported south by the evening drainage winds were detected in California, south and southwest of Test Cell C. The values shown in table 3 are from the combined activities collected by the glass fiber filters and charcoal cartridges.

Table 2. Five highest iodine-131 results and associated gross beta and radionuclide results from air sample media extrapolated to end of collection period (combined particulate and charcoal filters), Phoebus 2A EP V, July 1968

Location azimuth—distance[a]	Time on off	Date on off	Average concentrations during collection period and integrated concentrations									
			Gross beta		Iodine-131		Tellurium-132		Iodine-133		Iodine-135	
			pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³
Queen City, Summit, Nev.,[b] 16°, 66 miles	2014 1050	7/18 7/19	420	22	40	2.1	65	3.4	310	17	85	4.4
Hiko, Nev.,[b] 14 miles N, 40 miles W, 25°, 100 miles	1905 1305	7/18 7/19	410	27	28	1.9	75	4.9	180	12	47	3.1
Hiko, Nev.,[b] 14 miles N, 30 miles W, 30°, 96 miles	1825 1136	7/18 7/19	500	31	24	1.5	81	5.0	140	8.6	48	3.0
Coyote Summit, Nev.,[b] 6.8 miles W on Highway 25, 28°, 64 miles	1940 1015	7/18 7/19	480	25	22	1.2	74	3.9	140	7.2	75	4.0
Currant, Nev., Blue Eagle Ranch, 10°, 123 miles	2000 1110	7/18 7/19	290	15	17	.89	46	2.4	100	5.2	47	2.5

[a] Azimuth and distance from Test Cell C.
[b] Temporary sampler.

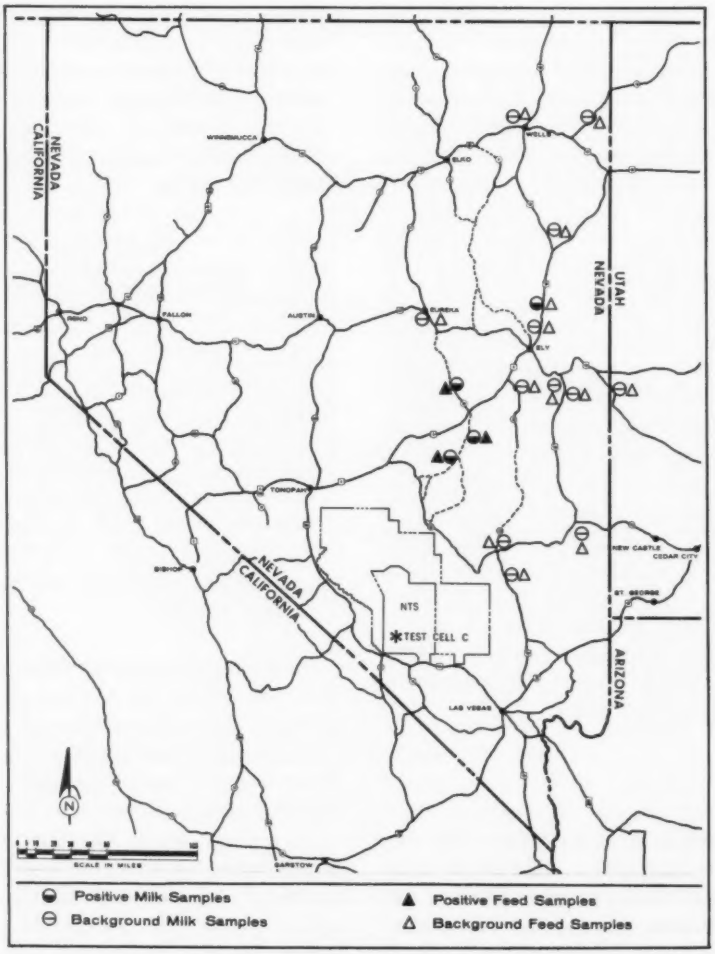

Figure 1. Milk and cow feed results—Phoebus 2A, EP V

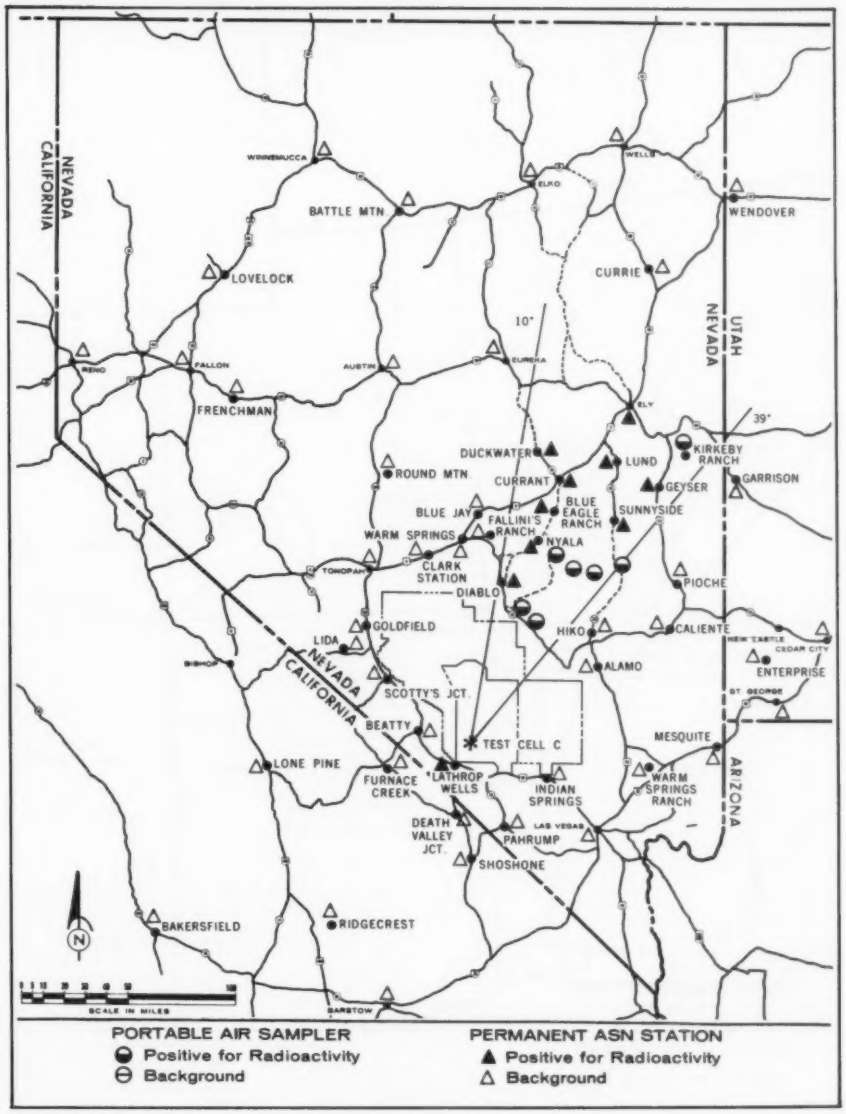

Figure 2. Air sampling results—Phoebus 2A, EP V

Schooner

Radionuclides released from this cratering experiment were chiefly tungsten-181 and tungsten-187. Deposition was detected throughout most of the Western United States (figures 4-7).

The peak gamma exposure rate observed by monitors with portable survey meters was 350 mR/h gross gamma at an unpopulated location near the Lincoln-Nye County line, just south of Nevada Highway 25. Peak exposure rate at a populated location was 8.5 mR/h gross gamma at the Diablo Highway Maintenance Station, 47 miles from surface zero (table 4).

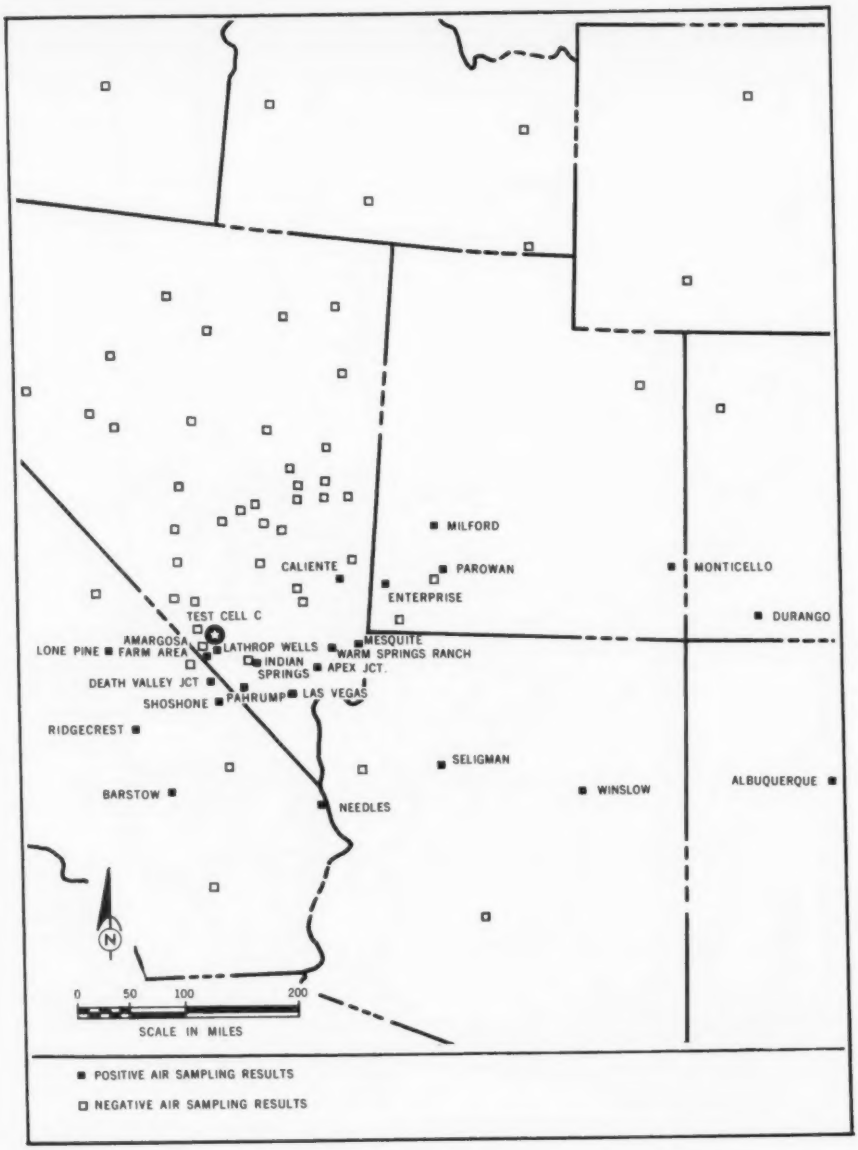

Figure 3. Air sampling locations—Pewee 1, EP III

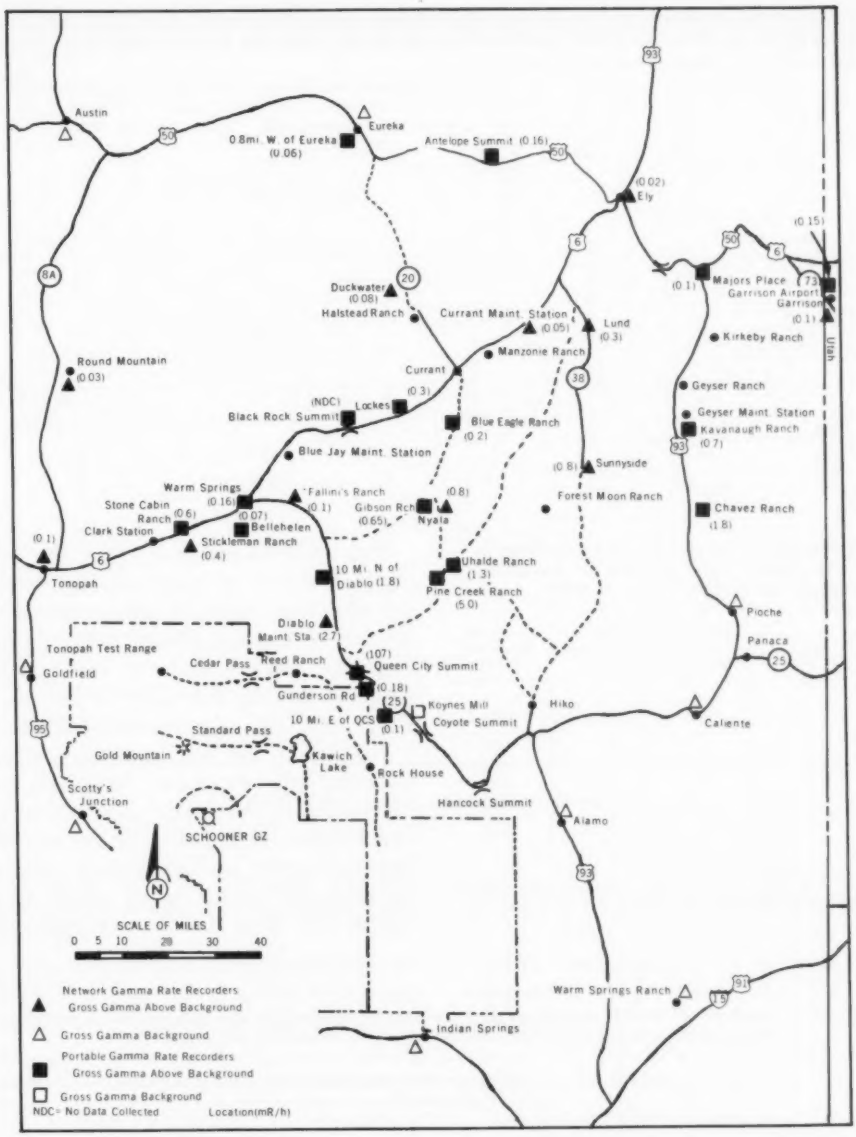

Figure 4. Maximum observed exposure rates by recorders—Schooner

Table 3. Five highest iodine-131 results and associated gross beta radioactivity and radionuclide results from air sample media extrapolated to end of collection period (combined particulate and charcoal filters), Pewee 1 EP III, December 1968

Location azimuth—distance[a]	Time on off	Date on off	Average concentrations during collection period and integrated concentrations							
			Gross beta		Iodine-131		Tellurium-132		Iodine-133	
			pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³
Lathrop Wells,[b] Nev., Henderson Ranch, 286°, 25 miles	1445	12/4	87	6.5	4.2	0.31	15	1.1	26	1.9
	1134	12/5								
Las Vegas, Nev., 128°, 82 miles	0800	12/5	63	5.5	3.4	.29	10	.86	7.0	.60
	0800	12/6								
Lathrop Wells,[b] Nev., Copeland Ranch, 208°, 26 miles	1420	12/4	82	5.8	3.4	.27	11	.88	18	1.5
	1225	12/5								
Lathrop Wells, Nev., 208°, 15 miles	1645	12/3	77	10	1.8	.2	5.3	.73	5.6	.77
	0640	12/5								
Indian Springs, Nev., 117°, 38 miles	0900	12/5	19	1.6	1.8	.16	8.9	.77	ND	ND
	0900	12/6								

[a] Azimuth and distance from Test Cell C.
[b] Temporary sampler.
ND, nondetectable.

Table 4. Five highest integrated gamma exposures at populated locations based on portable survey instrument readings, Schooner, December 8, 1968

Location Azimuth—distance from surface zero	Time of first reading above background	Peak reading (mR/h)	Integrated exposure (mR)
Diablo, Nev. 33°, 47 miles	1100	8.5	188
Chavis Ranch, Nev. 57°, 127 miles	(a)	3.1	70
Uhalde Ranch, Nev. 45°, 75 miles	(a)	[b]2.0	62
Nyala, Nev. 34°, 76 miles	1312	.5	26
Stone Cabin Ranch, Nev. 356°, 61 miles	(a)	[b]1.2	34

[a] Monitor arrived after cloud arrival.
[b] Monitor may not have observed peak reading; however, the reading is comparable to peak readings in adjacent area.

For several months after the event, small concentrations of radioactivity were found on air sampling media to the northeast of the NTS as far as Eureka. Small amounts of tungsten nuclides were found as far south as Lake Charles, La., on February 13 and 14, and Indio, Calif., on February 16 and 17, 1968.

Inasmuch as the masking effect of the tungsten-187 somewhat inhibited quantitating radioiodines, relatively low concentrations of radioiodine were not detected on filter media. Best estimates indicated that 1,000 pCi/m³ of tungsten-187 would mask about 10 pCi/m³ of iodine-131. This 100:1 masking ratio seemed

Table 5. Five highest tungsten-187 results and associated gross beta radioactivity and radionuclide results from air sample media extrapolated to end of collection period, Schooner, December 1968

Location azimuth—distance[a]	Time on off	Date on off	Average concentration during collection period and integrated concentrations									
			Gross beta		Tungsten-187		Iodine-131		Iodine-133		Iodine-135	
			pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³	pCi/m³	μCi-s/m³
Nevada: Clark Station, 356°, 55 miles	0955	12/8	200,000	8,500	280,000	12,000	28	1.2	680	29	120	5.1
	2145	12/8										
Warm Springs, 11°, 60 miles	0700	12/8	31,000	1,600	44,000	2,300	8.2	.4	ND		220	11
	2130	12/8										
Tonopah, 324°, 61 miles	1430	12/8	28,000	2,100	26,000	2,000	ND		ND		ND	
	1145	12/9										
Nyala, 36°, 77 miles	0800	12/8	15,000	720	27,000	1,200	ND		ND		ND	
	2125	12/8										
Kavanaugh Ranch, 52°, 133 miles	1150	12/8	37,000	1,300	36,000	1,200	ND		36	1.2	34	1.2
	2130	12/8										

[a] Azimuth and distance from surface zero.
ND, nondetectable.

Figure 5. Air sampling locations—Schooner

to hold for most filters. The five highest tungsten-187 results found in air samples are shown in table 5.

The highest tungsten-187 concentration in milk was 9,100 pCi/liter found in the December 9 sample from the Chavis Ranch north of Pioche, Nev. (table 6), and the iodine-131 concentration was 100 pCi/liter found in a December 11 sample collected near Abraham, Utah.

Table 7 presents the five highest tungsten-187 concentrations in water used for human consumption.

Table 6. Five highest concentrations of tungsten-187 in milk, Schooner, December 1968

Location azimuth—distance from surface zero	Date milked	Date collected (1968)	Time and date counted	Iodine-131 (pCi/liter)	Tungsten-187 (pCi/liter)
Nevada:					
Chavis Ranch 57°, 127 miles	12/09 p.m.	12/09	0015 12/10	<50	9,100
Chavis Ranch 57°, 127 miles	12/10 p.m.	12/10	2348 12/10	<50	7,300
Currant Mazonie Ranch 32°, 116 miles	12/09 a.m.	12/09	2345 12/09	<50	5,300
Casey's Ranch 39°, 82 miles	12/10 a.m.	12/10	2320 12/10	<50	4,400
Chavis Ranch 57°, 127 miles	12/11 a.m.	12/11	1000 12/11	<50	4,100

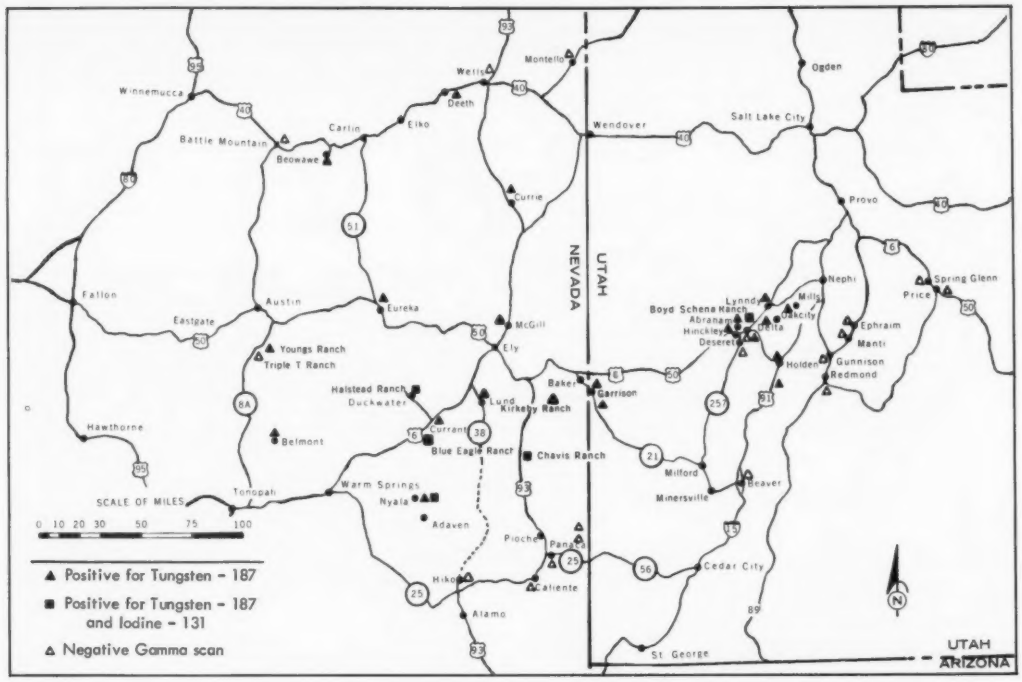

Figure 6. Milk sampling locations—Schooner

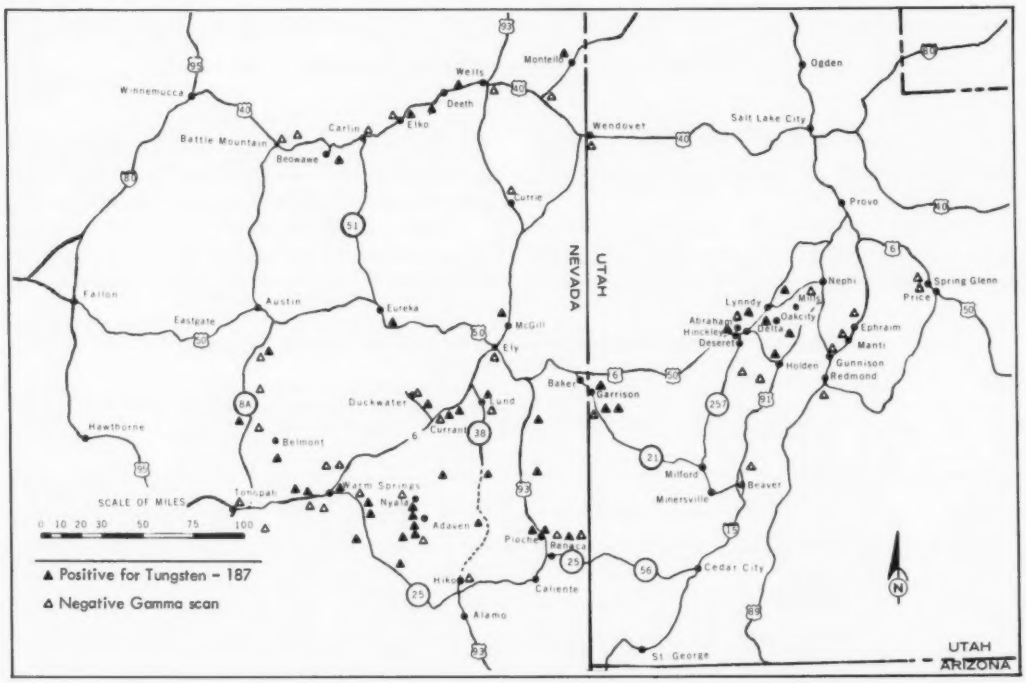

Figure 7. Water sampling locations—Schooner

Table 7. Five highest concentrations of tungsten-187 in water used for human consumption, Schooner, December 1968

Location azimuth and distance from ground zero	Date collected (1968)	Source	Tungsten-187 (pCi/liter)
Nevada:			
Simpson's Ranch, 42°, 75 miles	12/11	Spring	21,000
Uhalde's Ranch, 45°, 75 miles	12/10	Spring	10,000
Stone Cabin Ranch, 356°, 61 miles	12/11	Spring	8,300
Morrison Ranch, 11°, 167 miles	12/10	Well	2,400
Donahue Ranch, 63°, 145 miles	12/12	Stream	2,100

The maximum exposure shown by TLD or film badge was 4.76 R found at an unpopulated location 2 miles east of Queen City Summit. This exposure included cloud passage plus 5 days. One resident at a ranch about 75 miles from surface zero received 165 mR exposure while herding sheep along the line of maximum deposition.

Physiological parameters from ICRP II (*1*) were used to calculate a dose conversion factor for the ingestion of tungsten-187 based on beta radiation only. The dose to the G.I. tract is less than 40 mrad per μCi of tungsten-187 ingested.

Assuming that a person drank 1 liter of milk per day at the concentrations observed at Chavis Ranch, he would have consumed a total of 24,670 pCi of tungsten-187. If the entire ingested amount passes through the G.I. tract, this would correspond to an absorbed dose of about 1 mrad. Similarly, a dose of about 2 mrad can be estimated for a person drinking 1.6 liters of water per day having a concentration of 21,000 pCi of tungsten-187 as was observed at Simpson's Ranch.

Based on assumptions in FRC Report No. 5 (*2*), a peak concentration of 100 pCi/liter of iodine-131 in milk, observed at the Boyd Schena Ranch, would correspond to a dose of about 16 mrad to a hypothetical infant's thyroid. Since the FRC assumptions are based on fresh feeding conditions, this hypothetical infant dose estimate is conservative.

Conclusions

Using the critical receptor model, the maximum hypothetical thyroid dose calculated from iodine-131 in milk would be 16 mrad to a 2-gram infant thyroid as a result of Project Schooner. The sheepherder who received an exposure of 165 mR was in a location which is normally unpopulated.

Results obtained through environmental surveillance during this period indicated that no individual in the offsite area received an exposure from nuclear testing which exceeded the safety criteria established by the AEC.

Strontium-90 in Human Bone, July–September 1971[1]

Office of Radiation Programs
Environmental Protection Agency

To obtain data on the concentration of strontium-90 in man by age and geographical region, the Public Health Service began collecting human bone specimens in late 1961. Analyses of selected samples of people in older-age groups have shown their bone strontium-90 content to be low and age independent (*1*). Consequently, the target population includes children and young adults up to 25 years of age.

Although a few samples come from living persons as a result of surgical procedures, the majority are obtained post mortem. In the latter case, the specimens are limited to accident victims or persons who died of an acute disease process that was not likely to impair bone metabolism. For analytical purposes, a sample of at least 100 grams of wet bone is desired. Generally, this amount is readily available from older children, but it presents some difficulties in the case of infants and children under 5 years of age. Most specimens received to date have been vertebrae and ribs.

Laboratory procedures

The bones are analyzed at the Northeastern Radiological Health Laboratory, Winchester, Mass. Sample collection and preparation are explained elsewhere (*2*). Strontium-90 is measured by tributyl phosphate extraction of its yttrium daughter, which is precipitated as an oxalate. The strontium-90 content is then calculated (*3*) from the yttrium-90 activity. For the purpose of maintaining analytical reproducibility, "blind" duplicate analyses are performed on 10 to 20 percent of the samples.

The analytical results for strontium-90 in individual bones from persons dying during the third quarter (July–September) of 1971 are presented in table 1 in order of increasing age within each geographical region. These regions are indicated in figure 1. Reported values are

[1] Period during which death or surgical procedure occurred.

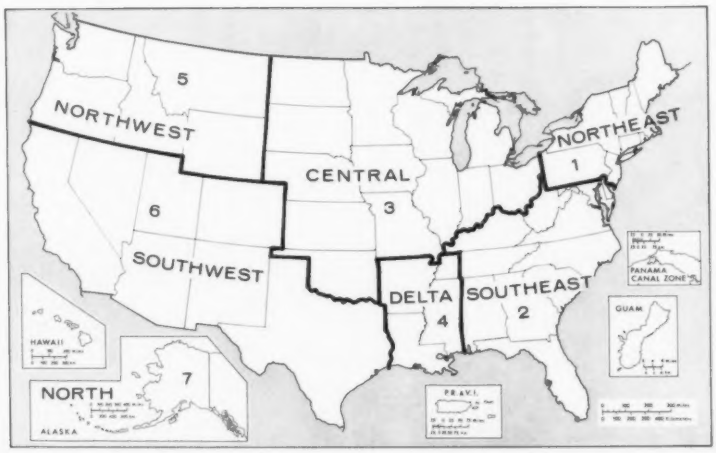

Figure 1. Geographical regions for human bone sampling

Table 1. Strontium-90 in human bone, July-September 1971

Bone region and State	Bone type[a]	Age[b] (years)	Sex	Strontium-90 concentration[c] (pCi/kg bone)	Calcium concentration (g/kg bone)	$^{90}Sr/Ca$ (pCi/g)
Northeast:						
New York	V, R, I	0	M	31.9± 6.6	35.8	0.89
	V, R, I	0	F	25.0± 5.9	28.7	.87
Massachusetts	V	3	F	91.1±11.7	36.7	2.48
New York	V	3	M	79.3± 9.5	29.2	2.72
	V	11	F	50.6± 6.5	33.4	1.51
New Jersey	V	13	M	140.2±12.0	56.2	2.50
	V	15	F	90.1±10.3	50.0	1.80
New York	V	16	F	58.7± 9.9	32.6	1.80
Pennsylvania	V	17	F	124.6±13.9	57.0	2.19
Vermont	V	19	M	105.0± 9.0	53.2	1.97
New York	V	19	M	66.8± 8.4	41.9	1.59
Pennsylvania	V	20	M	52.9± 8.3	53.2	.99
New York	V	20	F	50.0± 7.4	32.6	1.53
	V	21	M	128.4±14.8	47.8	2.69
	V	21	M	85.1±10.5	41.0	2.08
Pennsylvania	V, R, S	23	F	83.7± 9.6	60.8	1.38
	V	24	M	163.8±12.0	51.6	3.18
Southeast:						
South Carolina	V	3	F	253.1±21.4	36.5	6.93
Maryland	V	5	M	65.6± 9.8	25.9	2.53
	V	6	F	61.8±10.8	33.6	1.84
South Carolina	V	8	M	85.0± 8.6	32.0	2.66
Tennessee	V, R	8	F	33.6± 5.8	28.5	1.18
North Carolina	V	11	M	121.5±14.6	38.1	3.19
South Carolina	V	14	M	133.2± 9.2	45.6	2.92
District of Columbia	V	14	F	105.9±13.5	55.8	1.90
South Carolina	V	14	F	110.5±10.6	47.6	2.32
Kentucky	V	16	F	136.5±14.6	57.7	2.36
North Carolina	V	17	M	94.1±10.7	42.5	2.21
South Carolina	V	17	M	115.5± 8.7	48.9	2.36
Maryland	V	19	M	99.9± 8.5	49.3	2.03
	V	19	M	69.7± 8.7	49.4	1.41
South Carolina	V	19	M	197.2±13.5	57.8	3.41
Maryland	V	20	M	125.1±10.5	48.0	2.61
	V	20	M	120.4±10.0	55.8	2.16
	V	20	F	91.8± 9.0	47.4	1.94
South Carolina	V	20	M	134.3±13.7	60.4	2.22
	V	20	M	48.5± 5.2	33.3	1.46
Kentucky	V	20	M	110.6±13.6	57.5	1.92
Maryland	V	21	M	98.2±11.1	45.3	2.17
South Carolina	V	21	M	46.4± 5.3	35.0	1.32
Maryland	V	22	M	74.5± 9.1	50.0	1.49
	V	22	M	136.9±12.5	58.6	2.34
	V	22	M	78.8± 7.2	43.6	1.81
	V	23	M	83.0± 9.5	64.5	1.29
	V	24	M	91.3±10.2	56.1	1.63
	V	24	M	65.0± 6.7	46.1	1.41
South Carolina	V	24	M	171.8±14.3	57.1	3.01
	V	24	M	111.3± 9.9	62.0	1.80
Maryland	V	25	M	54.9± 8.7	43.4	1.27
	V	25	M	74.8± 9.1	52.7	1.42
	V	25	F	114.2±10.7	56.1	2.04
	V	25	M	50.6± 7.2	52.6	.96
	V	25	M	86.2±12.0	58.0	1.48
	V	25	F	91.3± 9.9	65.6	1.39
Central:						
Wisconsin	V	4	M	58.1± 8.4	31.0	1.88
	V	5	M	40.2± 5.4	24.3	1.66
	V	5	F	120.7±11.0	41.2	2.93
Ohio	V	5	M	73.4±11.0	38.9	1.89
Wisconsin	V	7	F	43.3± 6.8	33.1	1.31
	V	7	F	51.9± 7.5	31.7	1.64
Ohio	V	9	M	65.6±11.0	36.8	1.78
Minnesota	V	10	M	60.7± 8.5	35.2	1.72
Ohio	V	11	M	48.2± 7.0	35.1	1.37
Indiana	V	11	M	76.0± 9.1	40.5	1.88
Ohio	V	12	M	95.9±10.5	42.9	2.24
Wisconsin	V	12	M	99.3± 8.8	39.2	2.54
Ohio	V	14	M	93.8± 8.6	53.0	1.77
	V	14	M	148.2±13.4	63.5	2.33
	V	15	M	90.9± 9.3	44.2	2.06
	V	15	M	125.7±11.6	51.8	2.42
	V	16	M	128.4±12.6	47.4	2.71
Michigan	V	16	F	123.3±11.8	78.8	1.56
Ohio	V	16	M	91.1±10.3	56.1	1.62
	V	16	M	120.2±11.5	38.9	3.09
	V	17	M	92.6± 9.1	44.1	2.10
Minnesota	V	17	M	57.6± 6.0	42.5	1.35
	V	17	M	60.6± 8.7	44.1	1.37
Ohio	V	18	M	145.9±10.3	53.1	2.75
	V	18	F	155.6±15.1	70.3	2.21
	V	18	M	94.8± 8.8	53.8	1.76
	V	18	F	100.2±12.9	50.9	1.97
	V	18	M	82.3±10.0	49.0	1.68
	V	18	F	100.5±10.1	46.1	2.18

See footnotes at end of table.

Table 1. Strontium-90 in human bone, July-September 1971—continued

Bone region and State	Bone type[a]	Age[b] (years)	Sex	Strontium-90 concentration[c] (pCi/kg bone)	Calcium concentration (g/kg bone)	$^{90}Sr/Ca$ (pCi/g)
Minnesota	V	18	F	79.0± 7.7	47.9	1.65
Ohio	V	19	M	76.0± 9.4	68.4	1.11
	V	19	M	84.4± 8.1	57.5	1.47
	V	20	M	81.3± 8.9	49.0	1.66
	V	20	M	69.5± 9.0	54.0	1.29
	V	21	M	92.0± 8.0	42.2	2.18
	V	21	M	101.1± 9.9	59.1	1.71
	V	22	F	102.1±11.1	53.0	1.93
	V	22	M	73.4± 9.0	54.8	1.34
	V	22	M	80.6±11.0	51.8	1.56
	V	22	M	133.8±16.0	77.0	1.74
	V	22	F	69.6± 9.2	58.8	1.18
	V	22	M	69.5±11.2	56.1	1.24
	V	22	M	79.5± 7.9	53.8	1.48
	V	22	M	103.1±13.8	63.8	1.62
	V	23	F	94.2±13.5	54.4	1.73
	V	24	M	84.1±10.3	62.3	1.35
	V	24	F	53.4± 9.4	53.9	.99
	V	24	M	94.7±11.2	70.1	1.35
	V	24	M	106.2±11.0	59.0	1.80
	V	24	M	88.9± 9.2	74.2	1.20
	V	25	M	53.1± 7.4	44.3	1.20
Northwest:						
Oregon	V	13	M	39.7± 6.6	39.0	1.02
Washington	V	14	M	45.8± 5.7	27.8	1.65
Oregon	V	15	M	69.4± 9.1	56.3	1.23
	V	16	M	49.2± 6.5	38.6	1.27
	V	21	M	56.2±10.6	53.5	1.05
	V	24	M	54.5± 6.8	41.3	1.32
North:						
Alaska	V	18	F	646.3±55.1	134.7	4.80

[a] Type of bone: V, vertebrae; R, rib; I, ilium; S, sternum.
[b] Age given as of last birthday prior to death.
[c] Two-sigma counting error.

given in picocuries of strontium-90 per kilogram of bone (as rough indication of dose) and per gram of calcium (for comparison with other data and for purposes of model development). Two-sigma counting errors are reported for the bone concentration.

Following the pattern of earlier reports, subsequent articles will continue to provide interpretation of the data at appropriate stages in the program (*2–6*).

Recent coverage in *Radiation Data and Reports:*

Period	Issue
July–September 1970	June 1971
October–December 1970	September 1971
January–March 1971	March 1972
April–June 1971	May 1972

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Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission (AEC) receives from its contractors semiannual reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant environmental surveys are required.

Releases of radioactive materials from AEC installations are governed by radiation standards set forth by AEC's Division of Operational Safety in directives published in the "AEC Manual." [1]

A summary of the environmental radioactivity data follows for the Brookhaven National Laboratory.

[1] Title 10, Code to Federal Regulations, Part 20, "Standards for Protection Against Radiation" contains essentially the standards published in Chapter 0524 of the AEC Manual.

1. Brookhaven National Laboratory[2] January–June 1969

Associated Universities, Inc.
Upton, N.Y.

The Brookhaven National Laboratory (BNL) operations may affect the environmental levels of radiation in three ways: (1) by radioactivity in the cooling air from the research reactors (2) by radiation from an ecology forest gamma-ray source, and (3) by low-level radioactive liquid wastes released to a stream that forms one of the headwaters of the Peconic River (figure 1). The radiation levels resulting from reactor air effluent and the ecology forest source are monitored continuously by four stations located at the site boundary. The liquid waste effluent from the laboratory sewage processing plant is monitored continuously at the point where the stream leaves the site.

Area monitoring

The average weekly radiation levels at the Brookhaven National Laboratory site perimeter (figure 2), due to laboratory operations, are given in table 1. Radiation levels at the northeast perimeter are somewhat greater than at other monitoring stations due to a cesium-137 source located in the nearby forest. The radiation levels at this location were 15 percent of the established Atomic Energy Commission (AEC) radiation protection standard of 500 mrem/a for individuals in the general population. The levels at the other three perimeter stations are

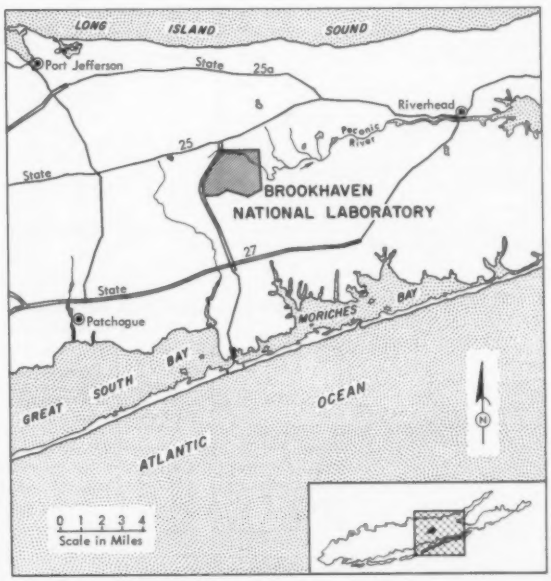

Figure 1. Brookhaven National Laboratory and surrounding area

[2] Summarized from "Effects of Brookhaven National Laboratory on Environmental Levels of Radioactivity during the First Half of 1969," Associated Universities Inc., Upton, N.Y. 11973.

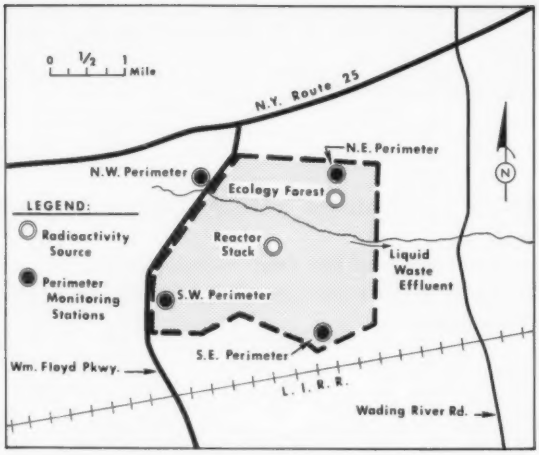

Figure 2. Brookhaven National Laboratory monitoring station locations

Table 1. External gamma radioactivity at BNL site perimeter due to laboratory operations, January-June 1969

1969	Average exposure rates (mR/week)			
	Northwest perimeter	Southwest perimeter	Southeast perimeter	Northeast perimeter
January	0.05	0.01	0.04	1.23
February	.04	.00	.14	1.30
March	.00	.00	.20	1.37
April	.00	.00	.00	1.47
May	.00	.00	.01	1.65
June	.43	.00	.09	2.04
January-June	.08	.00	.08	1.51
Highest weekly reading (January-June)	1.38	0.04	0.76	2.44
Average undisturbed background (January-June)	1.62	1.62	1.67	1.52

[a] Due principally to argon-41 in reactor cooling air and at the northeast perimeter, to the ecology forest cesium-137 source.

attributed to the Brookhaven Graphite Research Reactor being operated on a partially reduced schedule. Values of radiation background levels undisturbed by laboratory operations also have been included in table 1 for purposes of comparison.

Water monitoring

The liquid waste effluent from the laboratory sewage processing plant is monitored continuously at the point where the stream leaves the BNL site. The average concentration and total amount of gross beta radioactivity in the liquid waste effluent, at the site boundary, are shown in table 2 for January–June 1969.

Analysis of composite samples of the effluent has shown that, on the average, less than 20 percent of the radioactivity consists of strontium-90 and that no appreciable amounts of radioactive iodine or bone-seeking radionuclides, such as radium, are present. Under these conditions, the applicable AEC radiation protection standard for discharge of liquid waste to uncontrolled areas would be 1 nCi/liter. The observed concentration at BNL was 2 percent of the standard.

Most gross beta measurement instruments are not sensitive to low energy beta emitters, such as tritium, for which special analytical methods must be employed. The concentration and amounts of tritium found during this reporting period in the laboratory's liquid waste effluent are also shown in table 2. The applicable AEC standard is 3 μCi/liter, averaged over a period of 1 year. The observed concentration of tritium at BNL was 0.1 percent of this standard.

Table 2. Gross beta radioactivity in liquid waste effluent at BNL site boundary, January-June 1969

1969	Volume of flow (gallons/day)	Average beta radioactivity concentration (pCi/liter)	Total beta radioactivity concentration discharged (mCi)	Tritium concentration (nCi/liter)	Tritium radioactivity (Ci)
January	620,000	11	0.7	2	0.1
February	470,000	12	.6	2	.1
March	458,000	21	1.3	5	.3
April	682,000	14	1.0	2	.1
May	732,000	23	1.8	10	.7
June	403,000	15	.8	4	.3
January-June	[a]551,000	16	6.2	[a]3	1.7

[a] Not a straight arithmetic monthly average because it takes into account variations in volume of flow or the different number of days in each month.

Reported Nuclear Detonations, July 1972

(Includes seismic signals presumably from foreign nuclear detonations)

The U.S. Atomic Energy Commission conducted an underground nuclear test at its Nevada Test Site on July 20, 1972. The test was in the yield range of less than 20 kilotons of TNT equivalent.

Information in this section is based on data received during the month, and is subject to change as additional information may become available. Persons requiring information for purposes of compiling announced nuclear detonation statistics are advised to contact the Division of Public Information, U.S. Atomic Energy Commission, Washington, D.C. 20545.

U.S. GOVERNMENT PRINTING OFFICE: 1972—514-839/8

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